MACHINERY

DESIGN — CONSTRUCTION — OPERATION

Volume 36 MAY, 1930 Number 9

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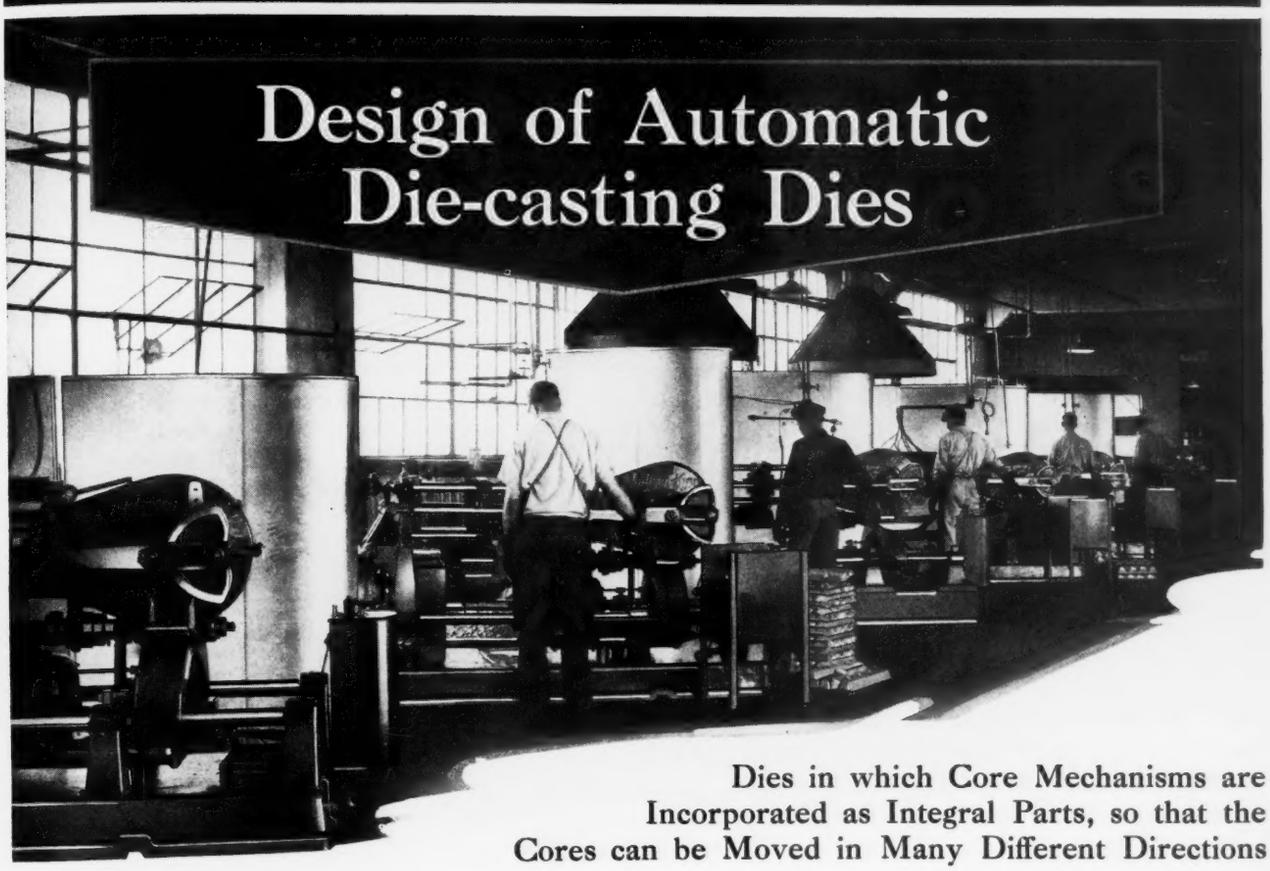
Volume 36 NEW YORK, MAY, 1930 Number 9

Design of Automatic Die-casting Dies



Dies in which Core Mechanisms are Incorporated as Integral Parts, so that the Cores can be Moved in Many Different Directions

By CHARLES O. HERB

AUTOMATIC operation of machinery generally results in increased production, lower costs, greater accuracy, and less fatigue on the part of the operator. Sometimes an additional advantage is obtained in the way of safer working conditions. Die-casting machines built by the Madison-Kipp Corporation, Madison, Wis., are so designed as to be completely automatic except for the movement of a control lever to start each casting cycle.

In these machines, the mechanisms employed for inserting the moving cores into the dies before the casting operation and for "pulling" them upon the completion of the operation are mainly incorporated in the dies themselves. The core mechanisms of movable dies are usually actuated by bell-crank levers or slides having rollers which engage cam-blocks mounted on long bars fastened to the machine. These combination bars, as they are called, may be attached to the machine at the top and sides. As the movable die carriage of the machine slides forward to close the dies and backward to open them, the core mechanisms are actuated.

Simplicity of the core mechanisms is achieved by this means, as it is an easy matter to arrange for the use of many cores which must be moved in any number of directions. Rack and pinion and other types of mechanism are employed for this purpose, as will be seen from the examples to be presented in a series of articles of which this is the first installment. While the movement of cores in movable dies only has thus far been discussed, means can be conveniently provided for moving cores in stationary die members as well. (A detailed description of the Madison-Kipp die-casting machine appeared in the February, 1928, number of MACHINERY, page 460.)

Dies for Carburetor Body of Complicated Design

In designing dies for producing the carburetor body shown in Fig. 1, provision had to be made for pulling a core at an angle of approximately 45 degrees from the horizontal or the vertical, in order to produce pocket *A* and the two recesses and holes that lead from it into the upper portion of the casting. Another core moving vertically had to be pro-

vided for forming the chamber within end *B*, this end being open. Various stationary cores were necessary on both the movable and the stationary dies, all of which were on horizontal axes. This carburetor body is illustrative of the accuracy with which diecastings can be produced, as most of the center-to-center distances between holes, and some of the surfaces, must be true to specified dimensions within 0.002 inch. The casting measures approximately 8 by 4 3/4 by 3 1/4 inches; it is made from a zinc-base alloy, and weighs 2 3/4 pounds.

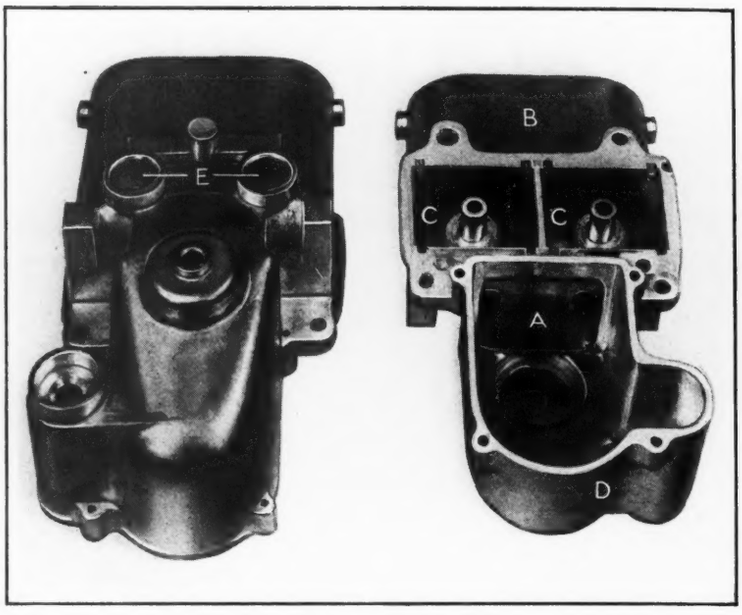


Fig. 1. Carburetor Body Produced in a Die Equipped with a Core that Must Be Moved at an Angle for Producing Pocket A and Recesses Leading from it

Figs. 2 and 3 show the dies made for producing the part; the stationary die member is at the left in each illustration and the movable die at the right. Pocket *A*, Fig. 1, and the recesses and holes that lead from it are formed by core *F*, Figs. 2 and 3, while the opening within end *B*, Fig. 1, is produced by core *G*. The construction of these cores may be clearly seen in Fig. 5, which shows the details of the movable die.

In Fig. 2 the movable die is shown with the moving cores in the casting positions. Fig. 3 shows this die with the moving members in the positions they occupy when the dies are open. The moving cores are pulled up or down as the case may be and the ejector pins pushed forward. When installed in the diecasting machine, the movable die is supported by brackets *H* from guide bars of the machine.

How the Moving Cores are Operated

Assuming that the dies are closed so that the sliding parts of the movable die are in the positions shown in Figs. 2 and 5, the four rollers attached to the sides of head *J* will occupy the lowest position

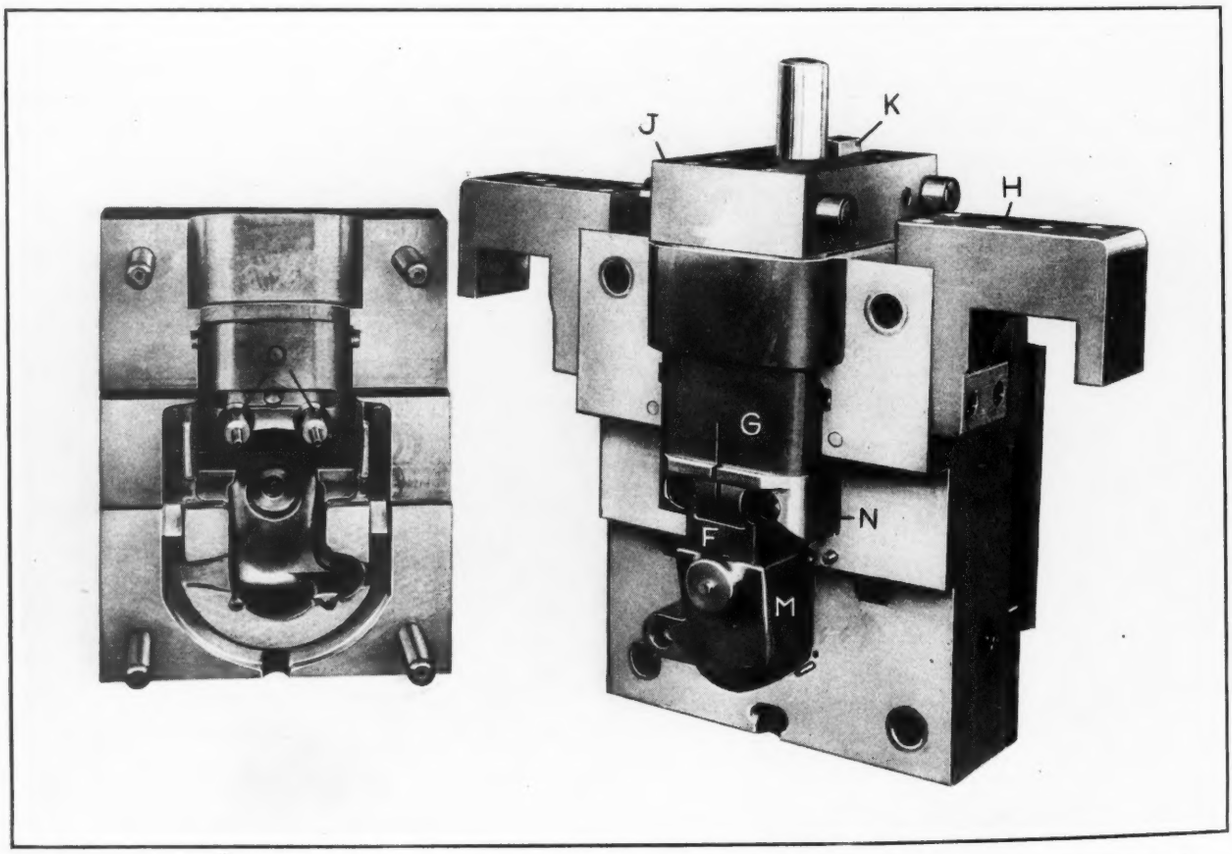


Fig. 2. Die Members Used in Producing the Carburetor Body, the Movable Die at the Right Being Shown with the Moving Cores in Their Casting Positions

on cam paths formed by blocks fastened to two combination bars mounted on the top of the machine. One of these bars is illustrated in Fig. 4. When the casting operation has been completed and the movable die carriage of the machine moves toward the left to open the dies, the rollers of head *J*, Fig. 2, are moved up the cam paths of the combination bars and thus pull core *G* vertically with the head.

When core *G* has been lifted about 3/8 inch, a bar *K*, Fig. 5, attached to head *J*, starts to move upward. Rack teeth at the lower end of this bar engage a long pinion *L* which, in turn, meshes with rack teeth machined on the lower end of core *F*. Thus, as head *J* moves upward, core *F* is withdrawn into the stationary core *M* to release the die-casting, and when the head moves downward to make the dies ready for the next casting operation, core *F* moves upward into the position shown. At *N* may be clearly seen the construction of the stationary cores which form openings *C*, Fig. 1. Core *M* forms the large chamber *D*. The lower end of core *G* is made flat so as to form a firm seat on the shelves formed by the upper surfaces of cores *N*.

From a comparison of the dies in Figs. 2 and 3, it will be obvious that the parting line of the casting is along the center of the oval section of end *B*, Fig. 1, and then runs horizontally to the face seen uppermost at the right in the latter illustration. The parting line follows this face to the lower end of the casting.

Cores *O*, Figs. 2 and 3, of the stationary die, which produce shouldered holes within bosses *E*, Fig. 1, are water-cooled by small channels that lead almost to the outer ends of the slender cores. The stationary die contains grooves or passages leading from the sprue which carry the molten metal to several different places in the die cavity. Pilot-pins on the stationary die enter bushings in the movable member to insure close die registry when the dies are closed.

Means Provided to Eject Casting from the Movable Die

Owing to shrinkage in cooling, the carburetor body always sticks to the movable member when the dies are open. Ejection of the casting is accomplished as the carriage of the machine nears the end of its stroke. At that time, a plate in back of the die, on which eight or ten pins *P*, Fig. 3, are mounted, is held stationary so that the die slides back over the pins, which thus eject the casting.

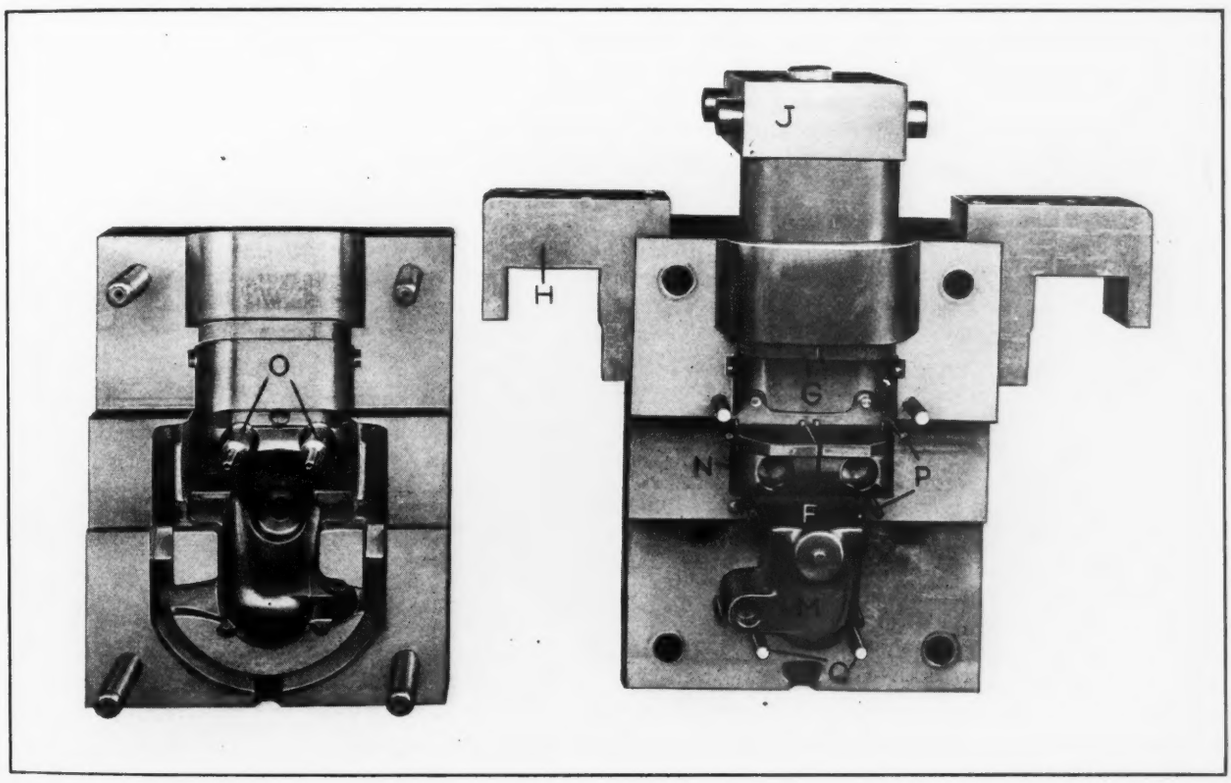


Fig. 3. Another View of the Carburetor Body Dies with the Two Moving Cores of the Movable Die Withdrawn

The ejector-pin plate advances with the movable die as the latter is brought into contact with the stationary die, and so means have to be provided for insuring complete withdrawal of the ejector-pins before the casting operation is performed. This is accomplished by four pins *Q*, Fig. 3, on the ejector-pin plate, which strike the face of the stationary die and thus force the ejector-pins back as required.

Another Example with Sliding Cores in Both the Movable and Stationary Dies

Dies of unusual interest were designed for casting speedometer brackets, two at a time, as illustrated in Figs. 6 and 7. The dies made up for these parts are illustrated in Figs. 8 and 11, the station-

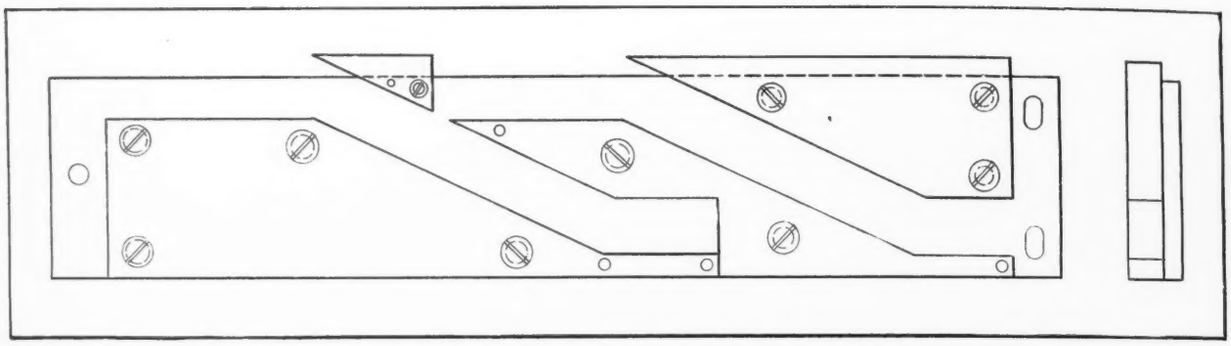


Fig. 4. Typical Arrangement of Cam-blocks Provided on Combination Bars of the Die-casting Machine for Imparting Movement to the Sliding Cores of Movable Dies

ary die being at the right in each illustration. Both die members are equipped with moving cores. In Fig. 8 the dies are shown with the moving cores in the positions they occupy when the dies are closed for the casting operation, while Fig. 11 shows the dies with the moving cores withdrawn. Three "shots" are made or six parts cast per minute with this die equipment. The parts are approximately 2 3/4 inches in diameter and are made of zinc.

One of the features of the movable die is the use of four sliding die-blocks for forming the threads of nipples *A*, Figs. 6 and 7. These blocks, which are shown at *F*, in Figs. 8, 9, and 11, must be moved apart to release the casting before the dies are opened, and they must be slid together before the dies are closed preceding an operation. Movement of the blocks is effected through three slides *G*, *H*, and *J*, which have rollers at the top that engage the cam-blocks fastened to two combination bars at the top of the machine. These combination bars are arranged in a manner similar to the bar illustrated in Fig. 4. Slides *G*, *H*, and *J* are pulled upward when the dies are opened and lowered as they are closed.

Rollers such as shown at *K*, Fig. 9, are fastened to the back of each die-block *F*. These rollers engage cam grooves of the type indicated by dotted lines *a* which are machined in the three slides. Thus, as the slides are pulled upward when the movable die is withdrawn, the cam grooves force the die-blocks sideways as required. Conversely, when slides *G*, *H*, and *J* move downward in closing the

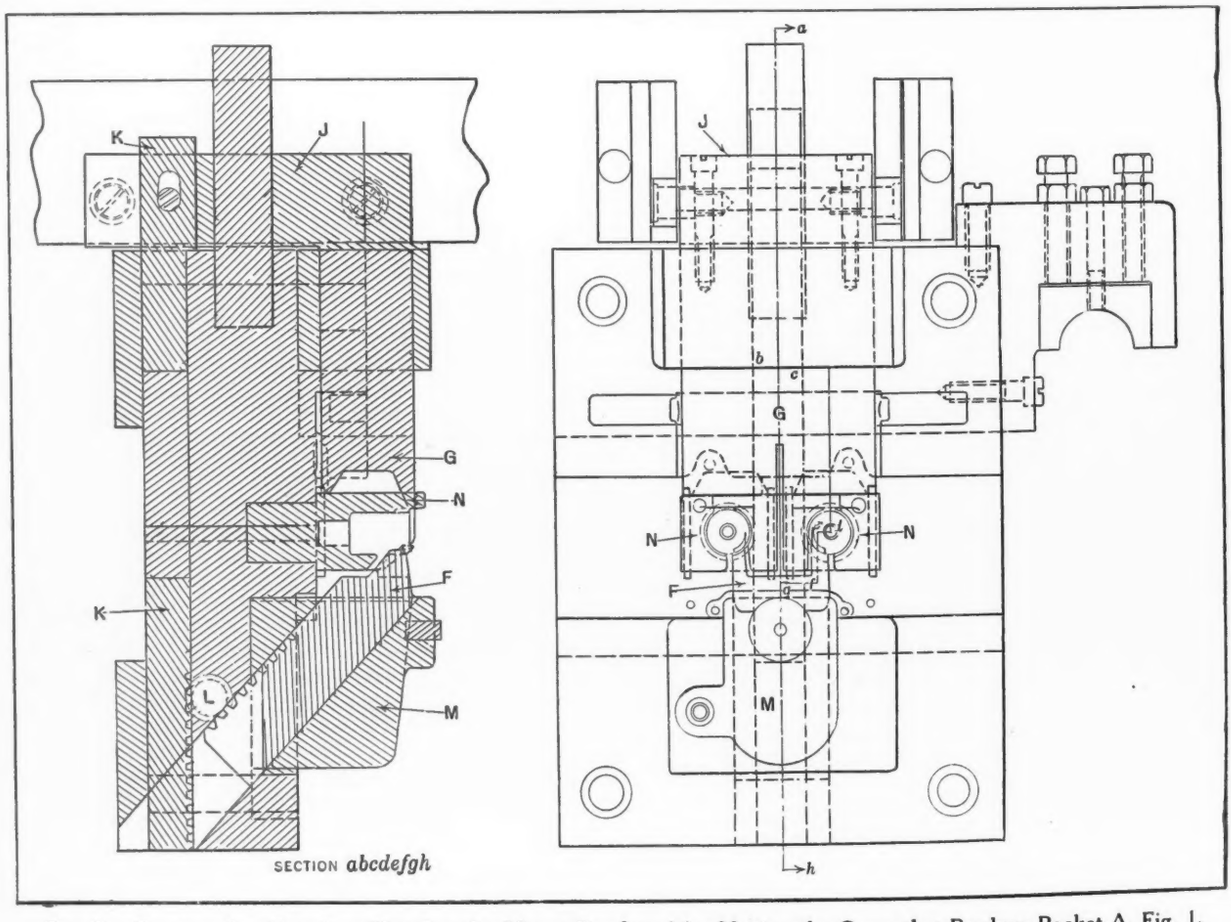


Fig. 5. Construction Drawing, Showing the Means Employed for Moving the Cores that Produce Pocket A, Fig. 1, of the Carburetor Body and the Opening in End B

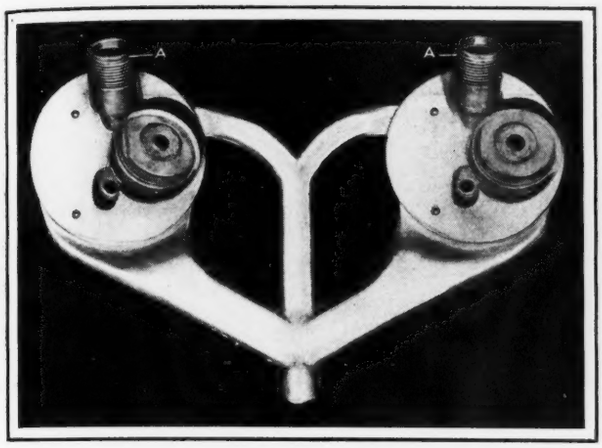


Fig. 6. Two Zinc Speedometer Brackets Cast at One Time

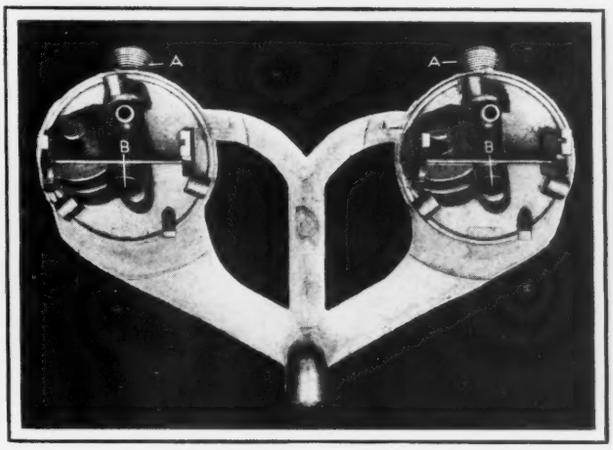


Fig. 7. Reverse View of Casting Illustrated in Fig. 6

dies, the blocks are pushed together firmly until the square plug *L*, Figs. 8 and 11, of the stationary die, can enter between the middle two blocks *F*.

Rack-and-pinion Mechanisms Move Long Slender Cores

Cores *M*, Figs. 8, 9, and 11 form the holes *B*, Fig. 7, which extend from the top of nipples *A*. The holes are 9/16 inch diameter in the nipples and 9/32 inch for the remaining length. The total length of the holes is 2 5/16 inches, and the cores used for producing them are moved that amount. This movement of the cores is effected through a rack *N* which is fastened to the back of slide *H*. The rack engages pinion teeth cut on shaft *O* which extends the full width of the die. Directly above each die cavity this pinion engages rack teeth cut in a sleeve *P* to which the corresponding core *M* is attached. Thus, as slide *H* moves upward to open the middle two blocks *F*, it also withdraws cores *M*, and when the slide moves downward to close blocks *F*, cores *M* are lowered into place.

Casting Ejected at an Angle from the Horizontal

Near the bottom of the movable die there is a rack *Q*, Fig. 9, which is actuated lengthwise by a lever attached to a special bracket on the movable die carriage, operated from one of the combination bars at the top of the machine as the carriage is moved back and forth. When this rack is pulled

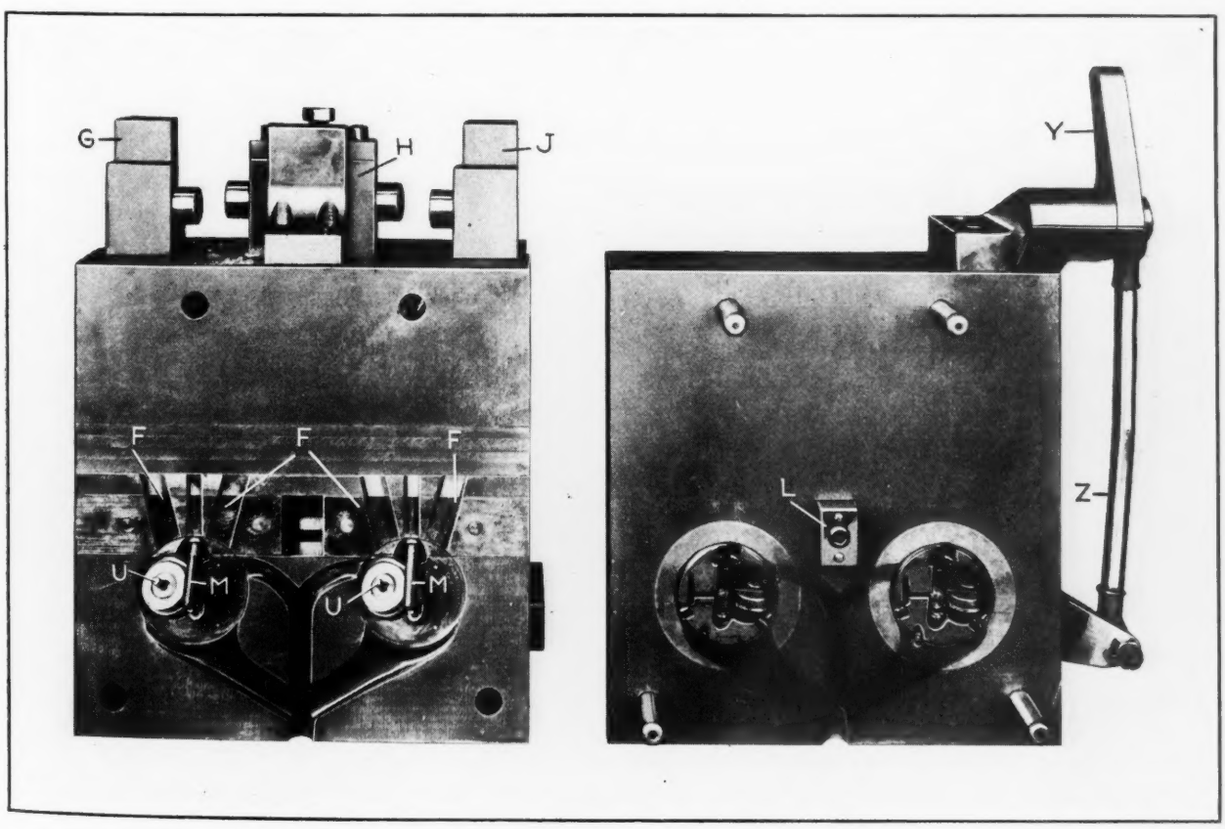


Fig. 8. Speedometer Bracket Dies in which Both the Movable Die at the Left and the Stationary Die at the Right are Provided with Sliding Cores and Thread-blocks

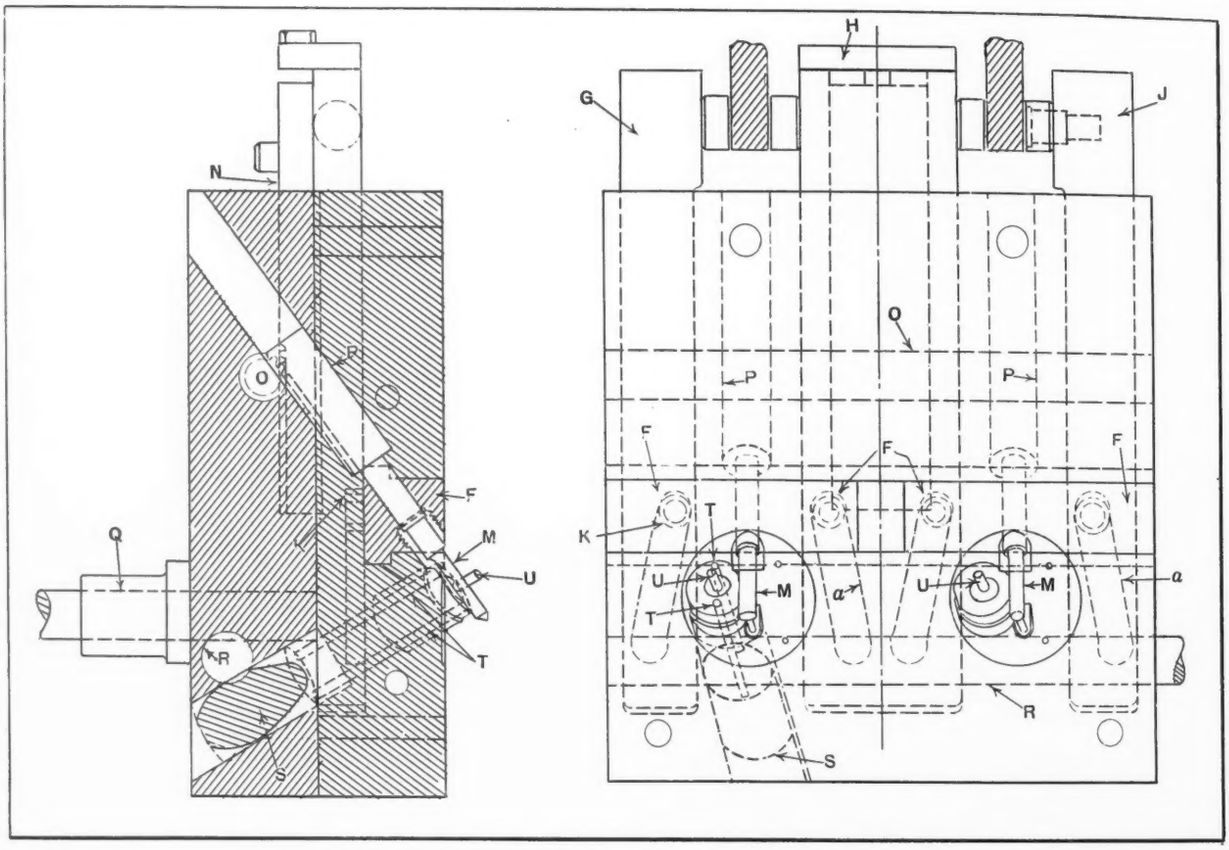


Fig. 9. Construction Drawing of Speedometer Bracket Movable Die, Showing Means Employed for Moving Sliding Thread-blocks, Long Slender Cores, and Ejector-pins

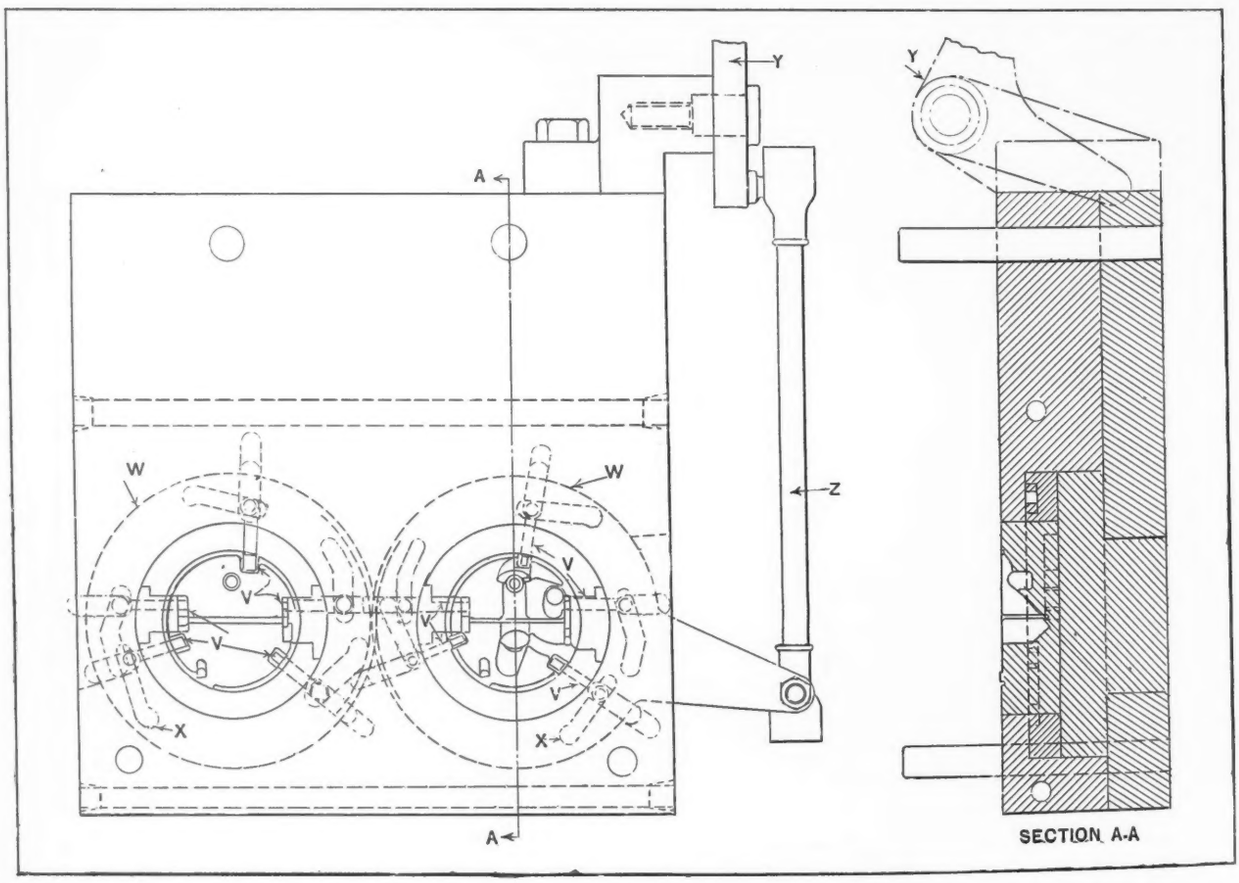


Fig. 10. Details of Speedometer Bracket Stationary Die, Illustrating the Use of Rotating Plates with Cam Grooves for Moving a Series of Cores in Different Directions

backward, it revolves a pinion shaft in hole *R*, the teeth of which engage rack teeth cut on two holders *S*, only one of which is shown in the front view of the illustration. Ejector-pins *T* fastened to holders *S* are thus pushed forward with their holders to force the casting from the movable die.

When this die was originally designed, the intention was to provide only two of these ejector-pins for each holder, as shown in Fig. 9, but as finally built, three ejector-pins were provided for each holder, as shown at *T* in Fig. 11. When the movable die is moved into contact with the stationary member, the same mechanism acts to withdraw the ejector-pins as shown in Fig. 8. Core-pins *U* are stationary.

From observation of Figs. 8 and 11 it will be seen that the sprue passages are contained entirely in the movable die. The operating line of the casting coincides with one side of the sprue web. Plug *L* effectively prevents any metal from entering between slides *F* as the "shots" are made.

Sliding Cores of the Stationary Die

Five holes are formed in the rim of each speedometer bracket through the use of sliding cores *V*, Fig. 10. These cores slide in five different directions but all in one vertical plane, so that they can be readily actuated through the use of plates *W* which have cam slots *X* cut in them, one for each core. Small rollers attached to the different cores engage these cam slots.

Just before the movable die withdraws from the stationary die after a casting has been made, bell-crank lever *Y* is swiveled through the action of a bell-crank lever at the rear of the machine which is actuated through the regular mechanism. Lever *Y* pulls rod *Z* upward and thus causes the right-hand cam-plate *W* to rotate on its axis. Spur gear teeth cut on the rim of this cam-plate mesh with similar teeth on the rim of the left-hand cam-plate, so that both plates are revolved in unison in opposite directions. As this occurs, all cores of both die cavities are withdrawn through the movement of the core rollers in grooves *X*. Converse action occurs after the movable die has been advanced against the stationary die when the castings are being made. All sliding parts of both die members are hardened. Pipe connections are provided for the circulation of water for cooling purposes.

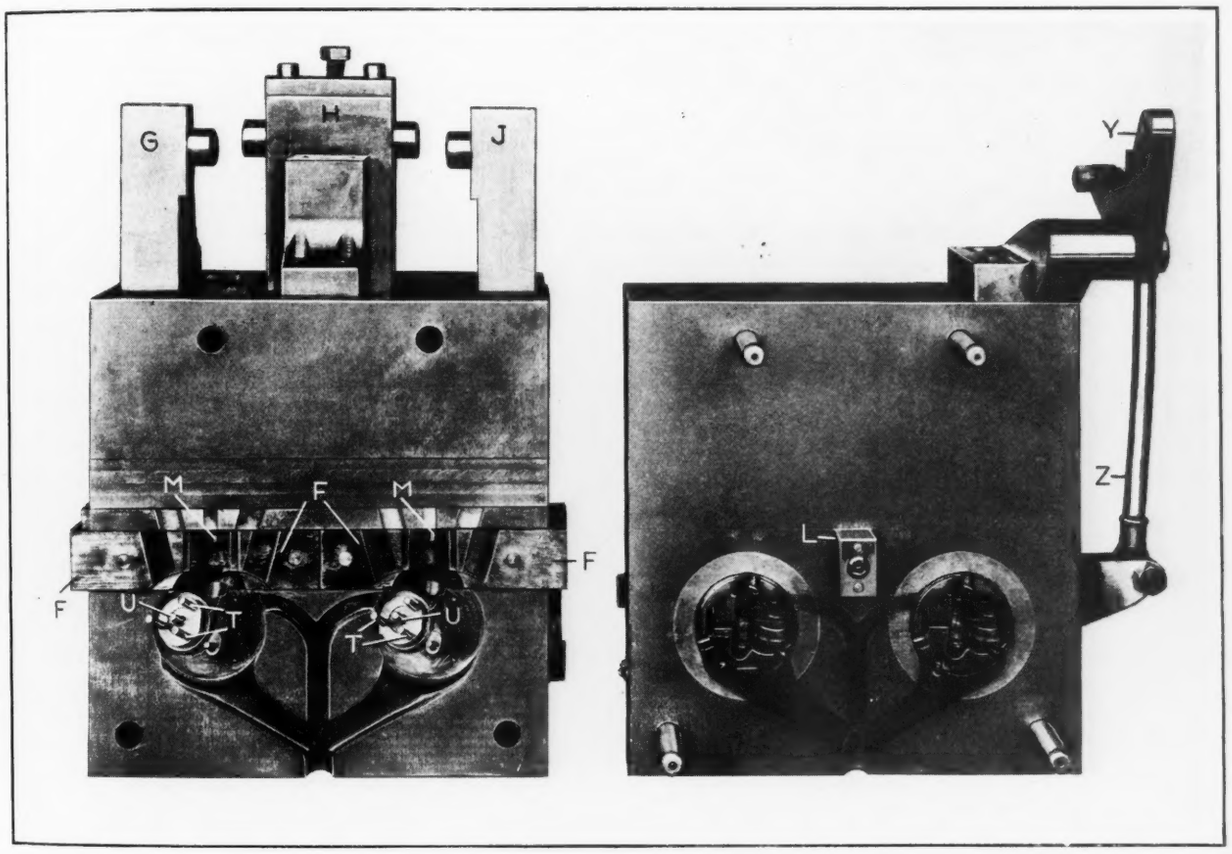


Fig. 11. Another View of the Speedometer Bracket Dies, with the Cores and Thread-blocks Withdrawn and the Ejector-pins Advanced

In both die examples given in this article, molten zinc is forced into the dies for the casting operation under a pressure of 350 pounds per square inch. (The next article will appear in July MACHINERY.)

* * *

Patent papers today simply bear the facsimile signature of the Commissioner of Patents, but early in the last century every patent was individually signed both by the President of the United States and by the Secretary of State, which indicates the importance that was placed upon inventions and patents in the early days of the Republic.

Inspecting Bar Stock by Magnetic Analysis*

Method of Testing Bar Stock for Aircraft Engine Parts by Means of a Magnetic Device which Detects Both Internal and External Flaws

By R. R. MOORE, Metallurgist, Wright Aeronautical Corporation, Paterson, N. J.

THE problem of building reliable aircraft engines is made especially difficult by the severe performance requirements and the demand for extremely light weight. To obtain the required lightness, the designer is often forced to employ the lowest permissible factor of safety. Thus, it is imperative that all the materials entering into the construction of airplane engines be as nearly perfect as it is possible to make them.

Physical tests and microscopic examinations of the materials, when properly performed, will determine satisfactorily the quality and adaptability of the pieces tested. The physical tests, however, cannot be applied to the materials that are actually used for the engine parts, as they destroy or damage the pieces tested. Obviously, such tests can be applied to only a very small percentage of the material used.

By inspecting as thoroughly as possible every piece of material used, the engine manufacturer not only guards against defective parts reaching the assembly departments, but in addition, avoids the expense of machining parts made from defective material that will not pass final inspection.

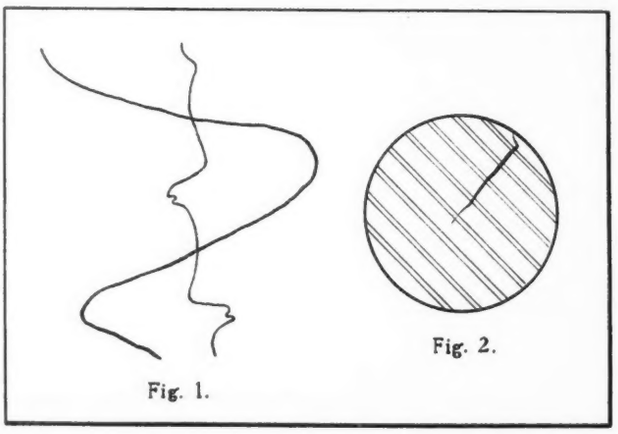


Fig. 1. Fig. 2.

Fig. 1. Oscillogram for Cracked Bar. Fig. 2. Diagram Showing Kind of Crack Found in Bar by Means of Oscillogram Shown in Fig. 1

Etching Test Used for Steel Bars

To secure a more thorough examination of steel bars, from which a large number of engine parts are machined, an etching test has been applied in addition to the usual physical tests and microscopic examinations. The etching test consists of immersing the steel bars in a tank of acid which eats off the scale accumulated during the hot-rolling and heat-treatment process, opens up the fine cracks, and reveals laps, seams, and other defects.

After etching, the bars are carefully examined all over, a magnifying glass of low power being used for this purpose if necessary. All major defects on the surface of the bar are usually detected by this examination. Its reliability is generally overestimated, however, for the reason that the complete examination of a long bar of steel in this manner is a very tedious job and the results are considerably influenced by the human element. Also, this method only detects surface flaws and does not indicate the condition of the steel below the surface. In many cases, surface defects are removed during machining operations, whereas internal defects remain.

Equipment for Detecting Internal Flaws

With the object of developing a reliable and practical method of detecting internal flaws, numerous investigators have studied the relation between the magnetic properties and the physical or metallurgical properties of steel. As a result, several types of instruments have been developed that reveal internal defects.

Recognizing the advantages of such testing methods, the Wright Aeronautical Corporation, Paterson, N. J., equipped its plant with a magnetic flaw detector, an instrument manufactured by the Magnetic Analysis Corporation, Long Island City. This equipment has been in use for about a year. All bar stock entering into the construction of the engines built by this corporation must be inspected by this flaw detector before it is accepted.

How the Magnetic Flaw Detector Functions

The steel bars to be tested are passed through two magnetizable coils placed a short distance apart and connected in series. In the center of each of these magnetizing or primary coils is a secondary coil. When the steel bar to be tested is passed through the magnetic field, an electromotive force is induced in the secondary coil. If the steel is normal, that is, free from various types of defects such as laps, cracks, seams, non-uniform structure, coarse grain, and other abnormalities, the characteristics of the induced electromotive force are the same as those of the primary current. If, however, the steel is abnormal, the induced electromotive force will be distorted.

Defects Recorded by Oscillogram

An oscillograph of special construction is connected to the apparatus and on this is recorded the

*Abstract of an article appearing in *The Tradewind*.

fluctuations of both the primary magnetizing current and the induced secondary current. The picture or record made by the oscillograph is called an oscillogram and is the means by which defects in a steel bar are located and their magnitude determined. An oscillogram for a bar containing a crack is shown in Fig. 1. The approximate size of the crack is indicated diagrammatically in Fig. 2. A crack of this kind would have been hard to locate without the aid of the magnetic flaw detector, because it is very fine at the surface of the bar and hence difficult to detect by a surface inspection.

Various types of defects are distinguished by the different forms of harmonics (or irregularities) shown on the oscillogram. The extent and character of the defect is indicated by the amplitude, character, and relative positions of the components of the harmonic. The indications of the harmonic may, in turn, be used to control suitably calibrated devices that designate which bars are to be rejected.

It is possible to set the indicating device to register only the presence of some particular kind of defect or of defects in excess of predetermined values. This is an advantage in routing inspection work, because it simplifies the inspector's job of locating the bars to be rejected. The instrument can be regulated to show great sensitivity, and will record variations in the metal that are difficult to detect by any other means.

The magnetic analysis method of inspecting steel has numerous other advantages. Primarily, it provides a practical means of inspecting all the bar stock that enters the plant. In addition to accomplishing 100 per cent inspection, the work is done with great speed. The material is not only examined for surface defects, but also for internal defects. It eliminates the bulky pickling equipment used in making acid tests, and thus removes a troublesome factor from plants making highly polished parts.

Reconditioning a Die-casting Machine

By W. E. WARNER

Die-casting machines are now used extensively for remetaling or relining bearings. After these machines have been in service for some time, they become worn to such an extent that reconditioning is necessary. The wear occurs principally on the piston and cylinder, the gear teeth on the rack that raises the piston, and the nozzles through which the molten metal is forced into the die.

The wear on the piston and cylinder is often severe, as these parts receive no lubrication other than the slight lubricating effect afforded by the molten metal. If the metal being cast contains any abrasive matter, the wear on the parts will be greatly increased. This condition is likely to exist, as old white metal, containing grit and other abrasive matter, is frequently melted down and cast by the machines. Whenever old metal is used, it should always be carefully cleaned first.

In overhauling a die-casting machine, the piston should be withdrawn from the cylinder and both of the parts examined for wear. The cylinder walls should be carefully examined for ridges and signs of scoring. If scoring or ridges are found, they should be removed by means of a circular lap. Next, the diameter of the piston should be carefully measured at different points with a vernier caliper in order to determine if the piston has worn out of round. The inside of the cylinder should be measured in a similar manner with a micrometer caliper, and the difference between the size of the piston and the cylinder determined.

The piston should be a sliding fit in the cylinder, with a clearance of approximately 0.002 inch. If the clearance between the cylinder and the piston becomes too great, the molten metal will escape at the under side of the piston and there will be loss of pressure on the molten metal. This loss of pressure will affect the quality of the die-casting. If the cylinder has a liner, it should be replaced with a new one when the wear has increased the clearance to such an extent that there is an appreciable loss or drop in pressure. When the cylinder is not fitted with a liner and the piston is undersize, a satisfactory repair can be made by turning a groove near the lower end of the piston and providing a piston-ring similar to that used on pistons of internal combustion engines.

When the piston is being replaced, a liberal quantity of flake graphite should be used between the piston and the cylinder or liner. Graphite is an excellent lubricant and will withstand high temperatures. If a liberal quantity of graphite is placed in the cylinder and the piston moved up and down, the graphite will be worked into the pores of both the piston and the cylinder walls. This treatment will substantially reduce the amount of friction developed between the piston and the cylinder. Any loose graphite remaining in the cylinder or on the piston should be removed with an air blast.

The teeth on the rack and pinion that raise the piston should be examined, and if these are found to be badly worn, the rack and pinion should be replaced. If the teeth are only slightly worn, they may be smoothed up with a file. Keeping the teeth well lubricated with machine oil will reduce wear.

The nozzle through which the molten metal is injected into the die should be inspected, and if the opening is worn excessively, a new nozzle should be used. The melting pot, heaters, metal passages, dies, etc., should all be cleaned and examined with a view to making repairs and replacements wherever necessary.

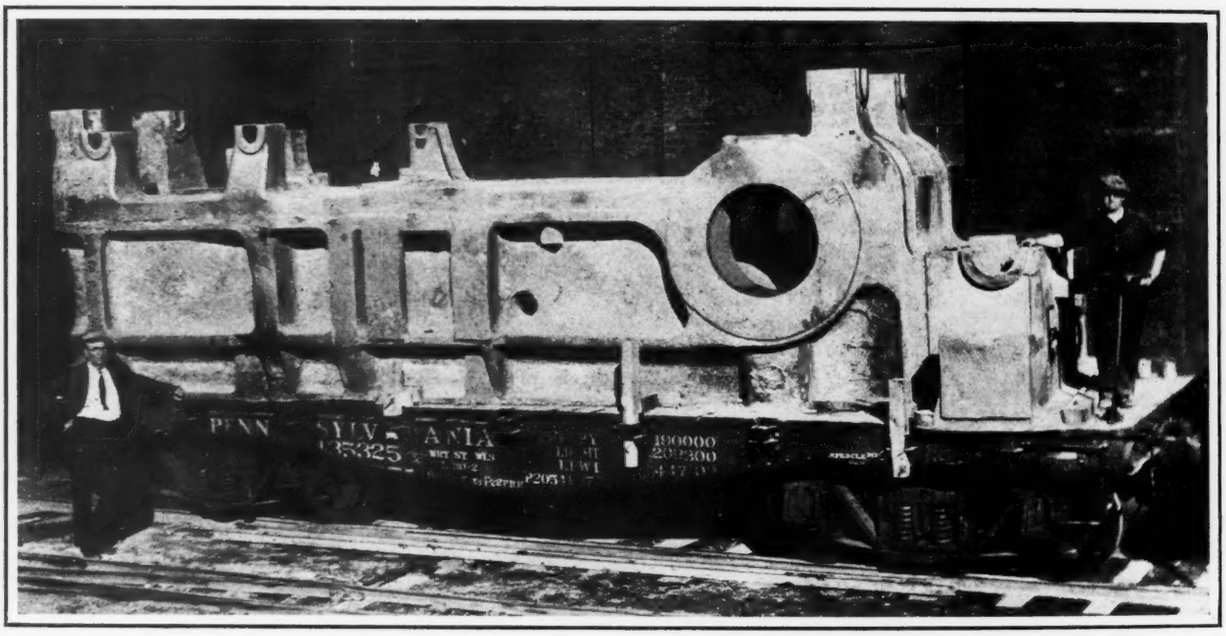
Notes and Comment on Engineering Topics

One of the Navy's first wrought-iron ships, launched eighty-seven years ago, the U. S. S. *Wolverine,* is still in service as a naval reserve training ship—an interesting indication of the resistance of wrought iron to the effects of time and corrosion.

Considerable progress has been made in the use of thermit welding in the steel mills during the past year, according to a paper presented before the American Iron and Steel Institute at its last annual meeting. The increase in the use of thermit welding in steel mills has been due not only to the reliability of the process for repairing breaks, but also to the development of special welding materials for building up worn parts, which are said to resist wear for a longer period than the original metal itself.

As New Orleans is located below sea level, artificial means must be provided for getting rid of rain water, which in other cities drains away naturally. The present pumping facilities at New Orleans have been found to be inadequate during heavy rains and new pumping equipment is being installed. Seven large pumps, together capable of pumping from 25,000 to 28,000 cubic feet of water per second will each be driven by General Electric 2000-horsepower, 6000-volt motors running at 94 revolutions per minute. Five smaller pumps, each driven by 1200-horsepower motors, will also be provided. The large pumps range in diameter from 14 to 18 feet.

A general conference held March 20 at Washington, D. C., under the auspices of the Division of Simplified Practice of the Bureau of Standards and attended by representatives of manufacturers, distributors, and users, unanimously approved a simplified practice recommendation covering the shapes and sizes of arbor holes for portable electric circular saws and grinding wheels. It was decided that the approved shape of hole for grinding wheels should be round, and for saws, either round or round with flat sides. The size of the arbor hole is to be 1 1/4 inches in diameter, with 1 inch across flats when flattened sides are used. This recommendation is to be effective January 1, 1931.



Bed casting of a 410,000-pound upsetter built by the Ajax Mfg. Co., Cleveland, Ohio, said to be the largest and most powerful machine of this type ever constructed. This casting is the largest and heaviest ever made by the Otis Steel Co. It required 128 tons of molten metal in its pouring.

It is mentioned in *Engineering* that the Swedish Government Railways have ordered roller bearings for 4000 iron ore cars for the Lapland Railway, on which between 8,000,000 and 9,000,000 tons of iron ore is transported annually. When the present order is completed, practically the entire rolling stock of this railway will be equipped with roller bearings. The railroad is situated almost entirely within the Arctic Circle. The most important advantage claimed is that it is easier to start a train in cold weather if equipped with roller bearings.

A section of the mile-long wrought-iron chain that was stretched across the Mississippi River in 1861 by the Confederate Army to impede the progress of General Grant has been recently discovered in a clay bank on the river. The links of the chain are said to be in excellent condition.

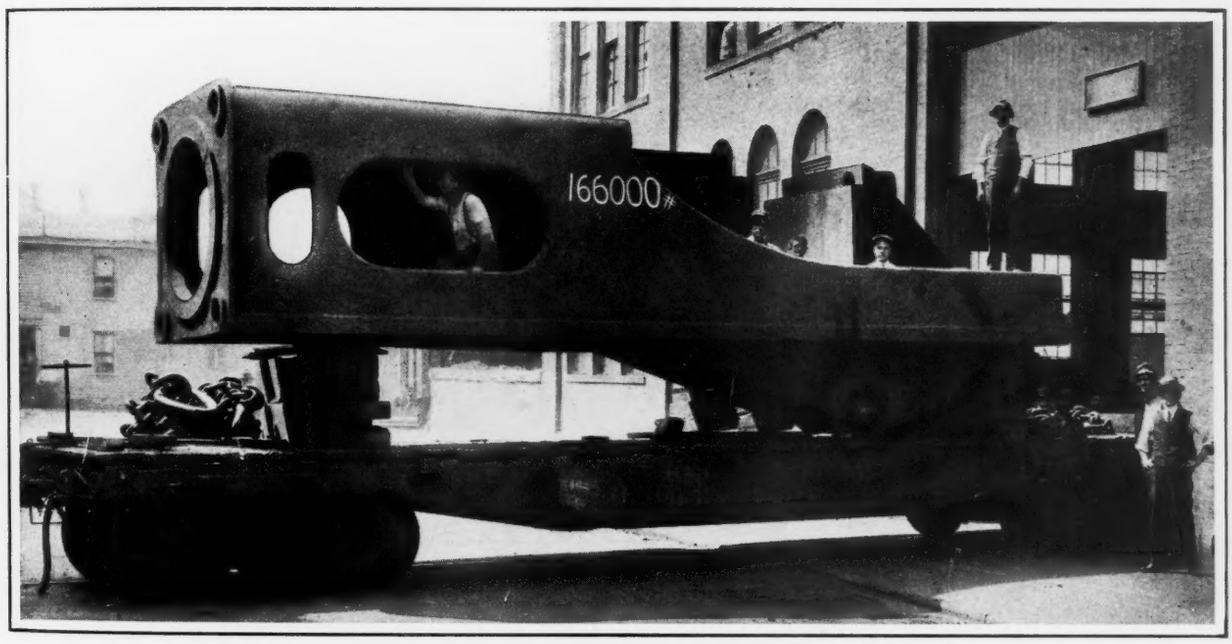
The first rivetless cargo vessel, an oil tanker 120 feet long and 23 feet wide, with a 10-foot draft, has just been completed by the Charleston Dry Dock & Machine Co., Charleston, S. C. According to information obtained from the General Electric Co., this vessel has been constructed entirely by the arc-welding process without rivets, bolts, or structural angles. The oxy-acetylene cutting torch was used for cutting plates and other parts to shape. The arc welding was done under a new system of dovetailed lock-notched plates developed by Richard F. Smith, a young ship designer. It is stated that 20 per cent in weight and 25 per cent in the cost of construction were saved by the arc-welding method, as compared with riveting.

The automobile industry consumes large percentages of the products of many industries. For example, 60 per cent of all the plate glass produced in the United States is used in automobiles. Twenty-five per cent of the rubber produced in the world goes into automobile tires, and 22 per cent of the world's production of tin is used in automobile production. Seventeen per cent of the world's lead is used in connection with automobiles, as is also 12 per cent of the copper. Fifteen per cent of the iron and steel manufactured in the United States goes to the automobile industry, and 80 per cent of the gasoline produced is used for propelling cars.

The average life of a nickel-chromium container for a lead hardening bath varies from 5000 to 7000 hours. Tempering bath containers have been in use for 13,000 hours with apparently no signs of deterioration, according to W. S. Scott of the Westinghouse Electric & Mfg. Co.

Some time ago Dean C. T. Humphrey of the Villanova School of Technology, Villanova, Pa., asked every dean of engineering in the United States to name those he considered the five greatest engineers of all time. The names selected by the deans of engineering are: James Watt, Leonardo da Vinci, Thomas A. Edison, James B. Eads (boat and bridge engineer), and Ferdinand de Lesseps (French engineer who built the Suez Canal and projected the Panama Canal).

The ten greatest engineers of the last twenty-five years were also named by the same group, as follows: Herbert Hoover, Charles P. Steinmetz, Thomas A. Edison, John F. Stevens, John Hays Hammond, George W. Goethals, George W. Westinghouse, Guglielmo Marconi, Henry Ford, and Ralph Modjeski. A lack of acquaintance with some of the great foreign engineers is evidenced in this list.



Another of the largest castings ever made. This casting is part of the equipment that was built by the Hooven, Owens, Rentschler Co., Hamilton, Ohio, for the Ford Highland Park power plant. When completely machined, ready for shipment, it weighed 166,000 pounds

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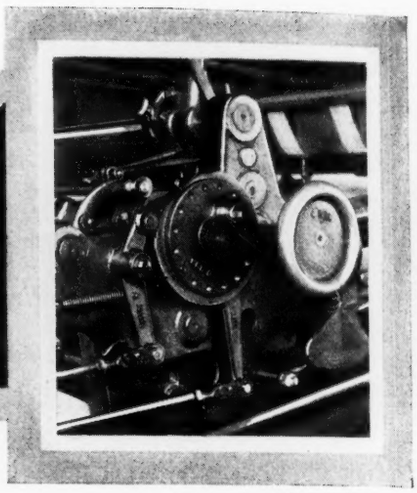
In a well-known New England machine tool plant we recently noticed an interesting feature in connection with the installation of a radial drill. In place of the usual table or bedplate, a very large special floor plate was provided, large enough so that when work set up on one part of the table was being drilled, a man could set up the next job on another part of the table. In this way, considerable time was saved and idle time greatly reduced.

Ingenious Mechanical Movements



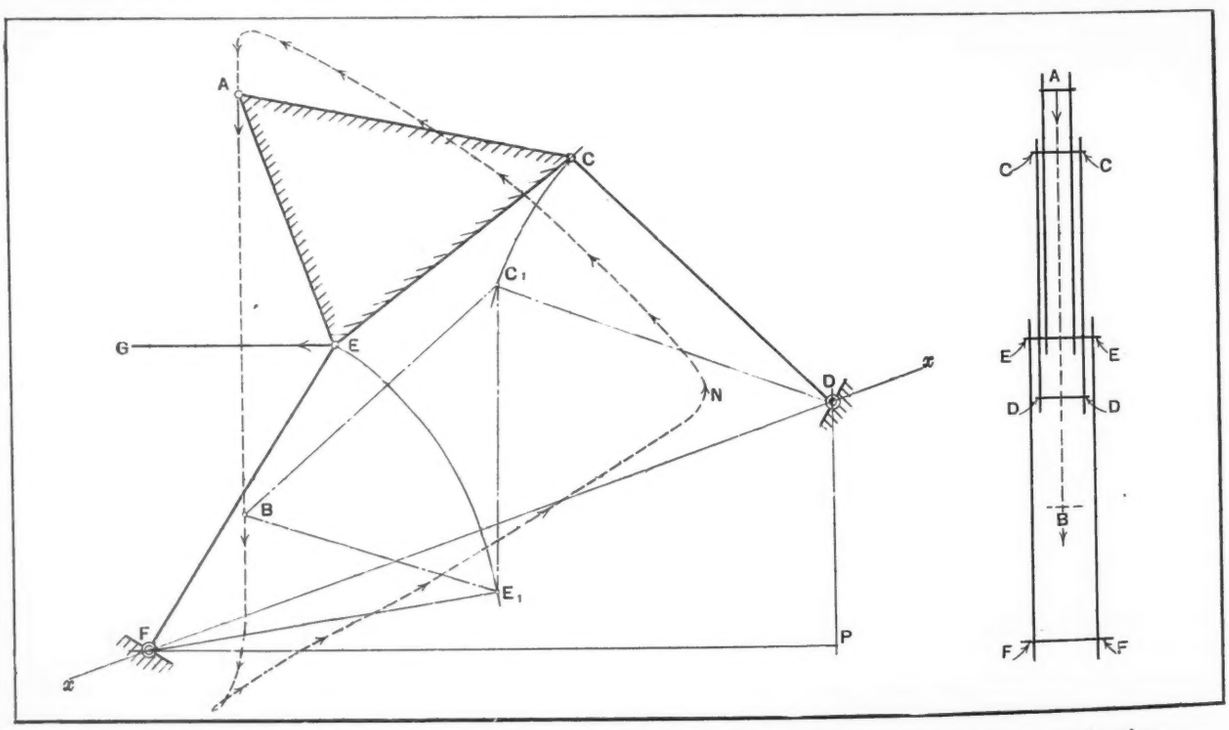
STRAIGHT-LINE MOTION FOR OIL CIRCUIT-BREAKER

By J. W. W. OW

Straight-line motions are not used extensively, since they are only adapted to certain special conditions, and they have some inherent disadvantages. The particular straight-line motion illustrated by the diagrams (which represent side and end elevations of the links) produces an approximate straight-line between the two points *A* and *B*. This mechanism is part of a heavy-duty oil circuit-breaker. Straight-line and toggle linkages have had considerable application to this type of electrical apparatus.

The pivots of what might be called the main lever are located at *A*, *C*, and *E*. The fixed pivots or hinge points are at *D* and *F*. The links *C D* and *E F* are free to rotate around their respective fixed pivots or bearings. The line *E G* indicates a link connecting with a crank or other form of driving member. A force indicated by the arrow at *A* acts along the path *A B*, and the triangular lever *A C E* moves from the "closed position" shown in full lines to the "open position" indicated at *B*, C_1, and E_1. This latter position represents approximately the lower limits of the main lever movement. The load from *A* to *B* varies in a manner characteristic of circuit-breaker operation, and the velocity in each direction also varies from zero to as high as 12 to 15 feet per second in order to operate the brushes fast enough to open or close in from 1/3 to 3/4 second. The load at *A* may vary from 150 to 3000 pounds during normal operation and may be higher under certain conditions. The line *A B* is vertical in the apparatus, and the line *F P* at right angles to *A B*. The diagram is very closely to scale, although reduced considerably in size from that of the actual apparatus.

In considering the advantages of this design, first note that the main lever *A C E* is a triangle



Diagrams Representing Side and End Elevations of Straight-line Motion for Heavy-duty Oil Circuit-breaker

with the load at one corner *A*. This form provides maximum strength and rigidity for a given amount of metal, and few straight-line motions, except the more complicated ones, have this feature. Second, the members *A E* and *E F* are struts well located with reference to the load at *A*. These struts are disposed to form the familiar toggle joint. Third, the rod from *A* to *B*, carrying the load, passes about midway between the points *E* and *F*, allowing proper clearances. Moreover, the rod is in the center of the double link *E F*, there being a link on each side, as shown by the end elevation; this is also the case with link *C D*. As the result of this construction the pins are in double shear and with practically no bending due to overhang. The line from *A* to *B* deviates only slightly from a true one and is accurate enough for the purpose mentioned. This motion has the advantage that the pivot points and links can be varied at one place and compensated for somewhere else to an extent not possible with a number of other types. All pivot points, however, must be in the proper relation to obtain the most accurate line, although this does not necessarily require the particular arrangement shown.

The real geometrical reference axis of this linkage is indicated by the line *x–x*. Note that the dotted line and small arrows starting from *A* extend through *B* downward curving to the left and then, after making a small loop, extend upward through *N* and back to the starting point *A*. This line indicates the path which point *A* would follow if the motion were continued beyond point *B* and through a complete cycle.

The four-sided linkage *C D F E* is similar in principle to the skeleton for most of the straight-line and parallel motions from Watts down to the Roberts type. The radius arms *C D* and *E F* are of equal length, but would not need to be, if the main lever *A C E* were changed to an isosceles form of suitable length and the center *D* were swung clear over the top until directly over pivot *F;* then the Roberts compensating motion would result. It will be noted that the path of point *A* crosses the axis *x–x* twice. If all the links in the linkage *C D F E* were of different lengths and if *C E* were longer than *D F*, and *C D* shorter than *E F*, then a point near the middle of the oscillating link *C E* would cross the axis six times. This will be recognized as the more general case of the irregular four-sided linkage. When crossed linkages are used, as in Watts and some other motions, the line is crossed only twice. From a practical standpoint this motion has a few decided and inherent advantages and it should be better known.

* * *

TRANSMISSION FOR ONE-WAY ROTATION

By FRED. L. NEWDICK

The purpose of the mechanism shown in Fig. 1 is to obtain a one-way rotation for the driven shaft regardless of the direction of rotation of the driver. In other words, the driver *B* may at any time, at the will of the operator, reverse its rotation without changing the rotation of the driven sprocket *H*, and this result has been accomplished by a very simple mechanism consisting of few parts, as the illustrations show.

Gear *C* and sprockets *B* and *F* are mounted on and keyed to the sleeve, which is bushed and revolves freely about stud shaft *A*. Sprocket *B* is driven by a reversing motor. Spur gear *D* is driven by spur gear *C*. Gear *D*, sprocket *H* and sprocket *G* all revolve freely on stud *E*. Sprocket *F* drives sprocket *G*. Since sprockets *F* and *G* are connected by chain, they rotate, of course, in the same direction. Gear *D* always revolves in an opposite direction to that of sprocket *G*.

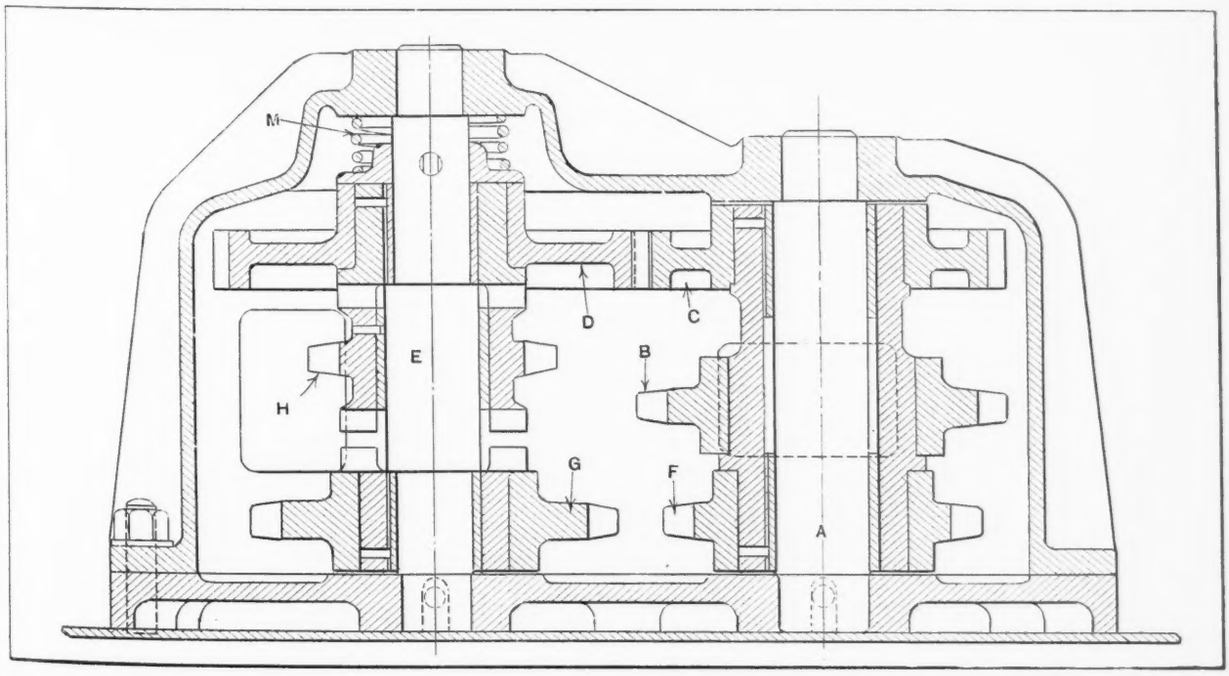


Fig. 1. One-way Transmission so Arranged that Reversal of Driver does not Change Rotation of Driven Sprocket

In the illustration the clutch teeth of sprocket *H* are shown in mesh with the clutch teeth of gear *D*. Assume that gear *D* and sprocket *H* are revolving in a clockwise direction and that sprocket *H* is to continue rotating in that direction. Suppose now that the rotation of sprocket *B* is suddenly reversed to a clockwise direction, thus causing gear *D* to revolve counter-clockwise. This change of motion, owing to the shape of the clutch teeth, will throw sprocket *H* over into engagement with sprocket *G*,

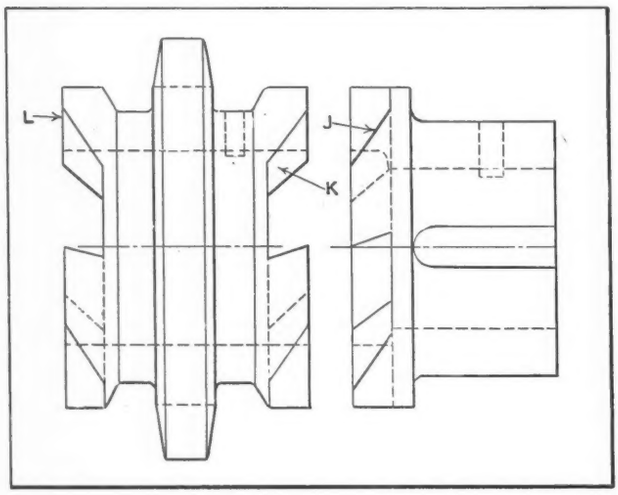


Fig. 2. Driven Sprocket of One-way Transmission and Form of Clutch Teeth Used

and the latter, which, of course, reversed its direction at the same time as shaft *B* will now be rotating clockwise, which is the direction desired for sprocket *H*.

Why a reversal of motion causes sprocket *H* to shift from engagement with the gear over into engagement with the sprocket will be apparent by referring to the detail view Fig. 2, which shows this sprocket and the gear clutch. When this clutch (which is a duplicate of the sprocket clutch) is driving the sprocket, the under-cut surfaces of the clutch teeth are in engagement, but when the rotation of the driving clutch member is reversed, the tapering surfaces *J* act against the corresponding tapers *K* on the sprocket, thus exerting a wedging or cam action which thrusts the clutch over into engagement with the opposite side.

When this shifting of sprocket *H* occurs, it is evident that the tops or lands *L* of the clutch teeth might strike the tops of the teeth, say, on sprocket *G* instead of entering the spaces between the teeth. If this should occur, there would be a serious wedging action between gear *D* and sprocket *G*, because the width of the clutch part of sprocket *H* is somewhat greater than the clearance space between the clutches on gear *D* and sprocket *G*. If such wedging action should occur, however, it would be relieved instantly by the lateral movement of gear *D*, which is free to shift against the action of spring *M*. This relieving movement would be followed quickly by the return of *D* to its normal position as the clutch on sprocket *H* snaps into place.

The machine on which this device is used consists of two conveyors driven by one reversing motor. One conveyor is reversed at the will of the operator, and the other must travel in one direction only. This mechanism has been fully covered by U. S. letters patent.

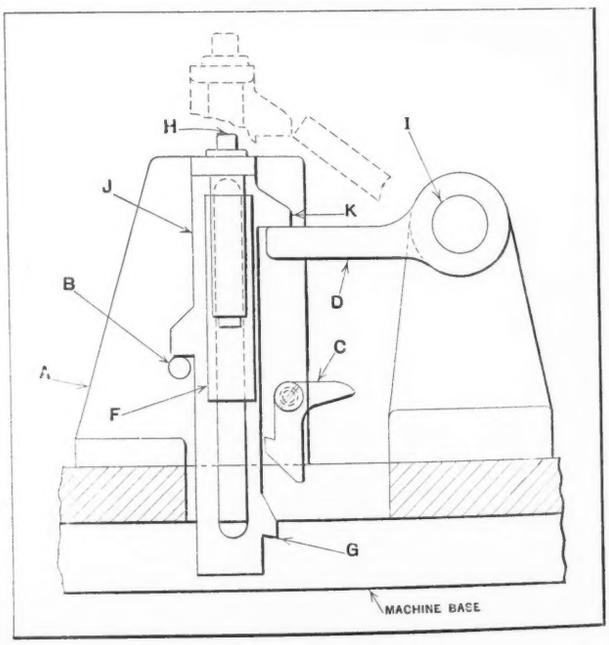
* * *

SLIDE WITH INTERMITTENT MOVEMENT AND QUICK RETURN

By J. E. FENNO

A mechanism designed to give an intermittent movement to a reciprocating slide is shown in the accompanying illustration. For every revolution of the shaft *I*, the slide *J* rises at a comparatively slow speed until it reaches the position shown by the dotted outline; the slide then dwells at this point for a certain period of time, after which it returns to its original position. These movements are secured through the action of the arm *D* on the latch *C* and on the projecting lug *K* of the slide. The end of the arm, rotating at a uniform speed, engages the lug *K* and raises the slide until the latch *C* catches on the lower lug *G*.

The slide is held in this dwelling position until the arm trips the latch, when the slide drops down on stop-pin *B* to the position shown, thus completing the cycle. A further motion of the arm raises the slide. The member of the machine on which



Slide Mechanism Producing an Intermittent Motion and a Rapid Return

the end *H* of the slide acts (not shown) returns under the action of a coil spring, carrying the slide back also. It will be noted that the angle through which the arm must turn to raise the slide *J* the required height is governed by the over-all length of the arm *D* and the location of the shaft *I*. The slide is confined in its path by the T-shaped gib *F* on the bracket *A*.

Designing Steel Springs for Two Loads

Method of Designing Small Steel Springs when Two Loads and the Height of the Spring at which Each Load is Applied are Specified

By H. M. BRAYTON, Ordnance Research Engineer, Picatinny Arsenal, Dover, N. J.

HELICAL springs made from round cross-section steel wire are used extensively in industry. Such springs may be roughly divided into two classes—those that must meet a fixed load at a given length, and those that must meet two different loads at two fixed lengths. Most of the information on spring design that has been published applies only to springs of the first class, and while the majority of springs manufactured fall in this class, nevertheless, there are many uses for small springs of the second class—that is, where it is necessary to control the load at two positions.

This article will deal only with small two-load springs made from small-diameter, unheat-treated, steel wire up to about 0.100 inch in diameter. The application of the usual spring formula to the two-load case will first be given. The accepted formula connecting the several variables is:

$$P = \frac{Gd^4 C}{8\,(D-d)^3 N} \qquad (1)$$

in which

P = maximum load, in pounds, equivalent to maximum spring compression;

d = diameter of wire, in inches;

D = outside diameter of spring, in inches;

N = total number of effective coils;

C = total compression, in inches, from free height to height equivalent to load P; and

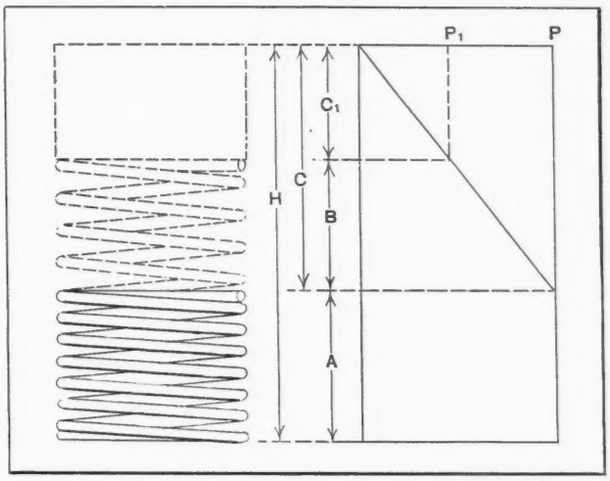
G = torsional modulus of elasticity.

For hard-drawn steel wire, such as music wire, the torsional modulus of elasticity, as given by most spring manufacturers, is 11,500,000 to 12,000,000. However, experience in the design of small steel springs covering about twelve years indicates that the maximum load P determined by Formula (1), if G is assigned a value of 12,000,000, does not correspond with the load actually carried by the spring. But if the value of G is 10,000,000 to 10,500,000, the maximum load obtained by Formula (1) will be very close to the actual load capacity of an unheat-treated spring made from steel music wire, provided the wire is not over 0.100 inch in diameter.

This formula, as given in Equation (1), is not readily applied to the design of a two-load spring. The data generally given in such a problem follows:

1. Two loads with the height of the spring at each load.
2. Maximum solid height.
3. Outside or inside diameter.
4. Maximum allowable fiber stress in the steel wire.

The accompanying diagram indicates a two-load spring and a load-deflection diagram. On this diagram, H is the free height of the spring; C_1, is the amount of compression from free height to the height that will give a load of P_1; C is the amount of compression for a maximum load P; B is the deflection between loads. Obviously, the distance C_1 is fixed when the loads P and P_1, the distance A, and the deflection B between loads, are fixed. The first step then is to calculate C_1. This is done by applying Equation (1) twice—once to each load; that is, to P_1 and to P. Thus, for P_1 we have:



Load-deflection Curve for Helical Steel Spring

$$P_1 = \frac{Gd^4 C_1}{8\,(D-d)^3 N} \qquad (2)$$

If now we divide Equation (2) by Equation (1) and cancel where possible, we have,

$$\frac{P_1}{P} = \frac{C_1}{C}; \text{ but } C = C_1 + B;$$

$$\text{Therefore } \frac{P_1}{P} = \frac{C_1}{C_1 + B}$$

Solving, we have,

$$C_1 = \frac{P_1 B}{P - P_1} \qquad (3)$$

The numerical values of P_1, P, and B are known from the original data of the problem, and so by the use of Equation (3) we can quickly obtain C_1 or the amount to add to the length at load P_1 to obtain the free height.

Wire Diameter and Number of Coils

The next step in the design of the spring is to determine the wire diameter and the number of coils necessary in order to obtain a practical design which will give the prescribed loads. By reference to Equation (2), it will be evident that if we know the outside diameter D of the spring and the value of the torsion modulus G of the steel, only two un-

knowns are left; namely, the number of coils N and the diameter of the wire d. With but one equation and two unknowns it is not possible, of course, to calculate them except by "trial and error"; therefore, assume a value, say, for d, and solve for N. If the value of N comes out absurdly large or small, make a second guess and again solve for N. Often, many trials are required before a proper combination of d and N are obtained. In this connection, it will be remembered that generally one of the basic requirements of springs is that the solid height must not exceed a given amount, which is the product of d and N, and if extra end coils are used, wound without pitch, these must be added to N to obtain the solid height. [In order to be able to design two-load springs quickly and accurately, the writer has designed simple charts, which save considerable time in determining the proper relative values of d and N, but unfortunately, these charts cannot be reproduced on a large enough scale within the limits of a page in MACHINERY.—EDITOR]

At the other extreme, it is possible to select such a small number of coils that the pitch is excessive and the resulting spring cannot be produced. Finally, before the design is acceptable, we must check the fiber stress produced by the maximum compression to which the spring will be subjected at load P. This stress is given with sufficient accuracy by the following formula, in which S equals maximum fiber stress, in pounds per square inch.

$$S = \frac{P\ (D—d)}{0.393d^3} \qquad (4)$$

The fiber stress to be allowed in a spring will depend entirely upon the use to which it is to be put. If placed in a vital part of a machine, its stress should be under 100,000 pounds per square inch. If the purpose of the spring is less important or if it is rarely called upon to function, the stress may be higher if necessary. Generally, it will be found possible to design a spring with a fiber stress below 100,000 pounds per square inch.

Typical Application of Two-load Spring

A typical application of two-load springs is a case where a spring is required to hold a sliding member in place against centrifugal force until a given angular velocity of the main part has been reached. When this angular velocity increases, the centrifugal force will cause the sliding member to move radially outward against the spring. This spring must be designed on the two-load basis in order to have the sliding member move outward uniformly. The slope of the load curve for the spring must be the same as the centrifugal force on the sliding member based on its ever increasing distance from the center.

There are many places where the energy given by a spring is essential, and this can be controlled by specifying two loads. It is just as easy to design and manufacture a small helical spring to meet two-load requirements as it is those that specify only one load or no load at all; hence, the designer should study his mechanism and decide whether or not it will function more accurately and perhaps more dependably if the slope of the load-deflection curve is controlled. If this slope is practically the same in each spring manufactured, then the force exerted at each deflection will be uniform and, what is probably more important, the energy exerted by each spring will be the same. Whenever uniformity of force between different springs is necessary for proper functioning of a mechanism, then the two-load theory should be applied.

If a mechanism such as a governor which operates by centrifugal force uses springs to hold a radial member in place until a predetermined angular velocity is reached, such springs should be designed with their load-deflection curve of the same slope as the centrifugal force-travel curve of the radial sliding member. If this is done, the member will slide completely to the open position as soon as the angular velocity has slightly exceeded the value set for operating, because the load on the spring will increase as it is compressed at exactly the same rate as the centrifugal force increases, due to the center of gravity of the sliding member moving farther from the axis of rotation.

Example Illustrating Design of Two-load Spring

As an illustration of how the formulas are actually used, suppose a spring is to be designed to meet the following requirements: Outside diameter, 0.50 inch; solid height, not over 0.85 inch; load at length of 1.25 inch, 6.25 pounds; load at length of 0.95 inch, 21 pounds 14 ounces (21.876 pounds); fiber stress, not over 100,000 pounds per square inch; value assumed for torsion modulus G, 10,500,000.

First obtain the value of C_1 from Equation (3):

$$C_1 = \frac{6.25 \times 0.30}{21.876 - 6.25} = 0.12$$

Hence, the free height of the spring $= 1.25 + 0.12 = 1.37$ inches.

The next step is to calculate the size of wire to be used and also the number of coils. As both of these variables appear in Equations (1) and (2), assume a value for the wire diameter d and solve for the number of coils N. Although it would be possible to assume a value for N and solve for d in either Equation (1) or (2), this would require the solution of a fourth power equation. Therefore, the wire size will be assumed and the problem will be to find a wire diameter that will give a reasonable value for N and at the same time satisfy the condition that the solid height of the spring must not exceed 0.85 inch and the fiber stress be within 100,000. After considering the size of the spring specified, assume that a desirable wire diameter is somewhere between a No. 25 (0.059 inch) and a No. 30 (0.080 inch) music wire gage.

Since the permissible solid height in this instance is 0.85 inch, it is evident that it would be possible to use about fourteen coils of 0.059-inch wire and about ten coils of 0.080-inch wire. By transposing Equation (2)) and solving for N, we can determine whether any wire diameter within the minimum

and maximum sizes selected will give a reasonable value for N. Thus:

$$N = \frac{Gd^4C_1}{8\ (D—d)^3\ P_1}$$

The value of N for the 0.080-inch wire will be determined first. If G is given a value of 10,500,000 then,

$$N = \frac{10{,}500{,}000 \times 0.080^4 \times 0.12}{8 \times (0.50 — 0.080)^3 \times 6.25} = 14 \text{ coils,}$$

approximately

As fourteen coils is too many, try solving for N again when the wire diameter equals 0.059 inch:

$$N = \frac{10{,}500{,}000 \times 0.059^4 \times 0.12}{8 \times (0.50 — 0.059)^3 \times 6.25} = 4 \text{ coils, nearly}$$

This number of coils, or four, is too small, but a wire diameter about half way between the minimum and maximum sizes selected evidently will require a number of coils more nearly consistent with a spring of the size given. Suppose we select No. 28 music wire (0.071 inch). Then:

$$N = \frac{10{,}500{,}000 \times 0.071^4 \times 0.12}{8 \times (0.50 — 0.071)^3 \times 6.25} = 10 \text{ coils}$$

nearly

The solid height equals $0.071 \times 10 = 0.71$ inch or less than the maximum of 0.85 inch specified. The next step is to determine the fiber stress S when the spring is subjected to the maximum load P. This stress may be determined by Equation (4):

$$S = \frac{21.876 \times (0.50 — 0.071)}{0.393 \times 0.071^3} = 67{,}000 \text{ pounds}$$

per square inch, approximately

This stress is well within the limits prescribed.

Permanent Set of Springs and Specifications

It is well known that when springs are wound, it is possible to shorten them somewhat by repeated compressions to solid height. Generally 50 to 100 compressions are sufficient to remove this so-called "permanent set." In manufacturing springs, this fact must be considered, and the designer should specify dimensions, loads, etc., of the finished spring after the set has been removed. A second method of removing the set from a spring is by a low-temperature heat-treatment. This method slightly increases the loads given by the spring.

The drawing of a small helical spring should give sufficient information to enable the manufacturer to make it on a spring winding machine and at the same time take care of the changing characteristics of the wire used. The data which is recommended to be placed on a spring drawing follows:

1. Outside or inside diameter of the coil—preferably the former—with a reasonable tolerance. For small springs, that is, up to 1 inch or so in diameter and with wire not over 0.090 inch diameter, a total tolerance of 0.010 inch should be sufficient.

2. Diameter of wire with the tolerance used by the makers of music wire. This varies from a total of 0.00025 inch for wire of 0.004 inch diameter to a total of 0.002 inch for 0.090-inch diameter wire.

3. Free height of spring followed by the word "approximate." This is one of the factors that the manufacturer should be permitted to vary in order to secure the important requirements.

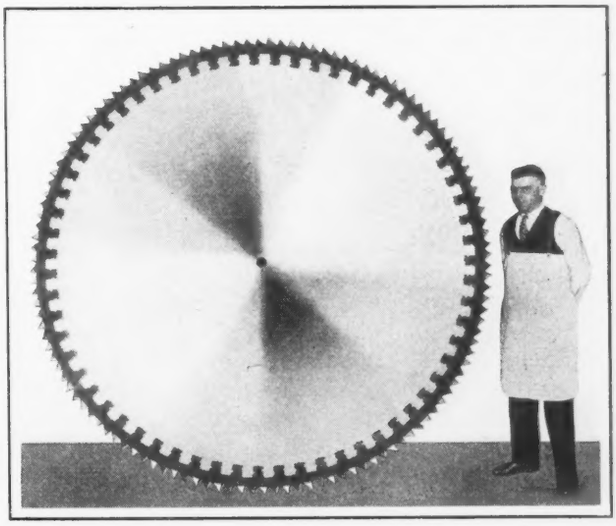
4. The load at each of the two required lengths, specified with a total tolerance of about 20 per cent of the load.

5. The number of coils with as liberal a tolerance as possible. If too many coils are used, the maximum solid height will be exceeded, and if too few are used to increase the loads without a change in the free height, the pitch will become so great that the additional permanent set will offset any gain made by a reduction in the number of coils. These limits should be set by the designer. It aids the manufacturer considerably if the number of coils can be varied even slightly, and within limits, the designer can generally permit it.

* * *

WOOD SAW OF RECORD-BREAKING SIZE

What is believed to be the largest circular wood-cutting saw of the inserted-section tooth pattern that has ever been made was recently completed by the Simonds Saw & Steel Co. in its Portland, Ore., shop. This saw, as shown in the accompanying



A Wood-cutting Saw, 10 Feet in Diameter, Provided with Inserted-section Removable Teeth

illustration, is 10 feet in diameter. Removable sections, each containing two teeth of hardened steel, are inserted and locked in the plate or body of the saw. The tooth sections are interchangeable.

* * *

Concentration does not, as is popularly supposed, mean keeping the mind fastened on one object or idea, or in one place; it consists in having a problem or purpose constantly before one.—*Henry Hazlitt*

Current Editorial Comment

In the Machine-building and Kindred Industries

FACTS VERSUS OPINIONS

Two machines of entirely different designs were employed in the same shop for performing similar operations. When additional machines were to be installed, the foreman of the department objected to one of the types because of the frequent shut-downs necessary for minor repairs. The builder of the machine had been unable to overcome this difficulty. This machine gave trouble once or twice a week, while the other type would run for months without attention.

The superintendent of the plant differed from the foreman as to the comparative value of the two machines, and consulted the records that were kept of all breakdowns. He found that the machine that frequently gave trouble was shut down for about an hour at a time when repairs were necessary, but that the total shut-downs did not average more than about six hours a month. The other machine ran for three or four months without repairs, but would then require a complete overhauling, interrupting production for a week or more. Hence, the machine that required frequent attention was out of service only about one-half as many hours during the year as the machine that was overhauled at less frequent intervals. The records proved the value of basing conclusions on facts rather than on opinions.

* * *

SAVING MATERIALS BY THE USE OF TUNGSTEN-CARBIDE TOOLS

In computing the savings realized from the use of tungsten-carbide tools, many production engineers seem to have overlooked the saving in material made possible through the use of these newly introduced tools. In many manufacturing plants, the cost of labor is considerably less than the cost of the materials used, and the savings in labor costs effected by the use of tungsten-carbide tools are often less important than the savings in materials.

For example, it is possible to make smaller allowances for finishing castings, because the new cutting tools are not affected by the hard surface scale and it is not necessary to cut under the scale to the same extent as with other tools. It is also possible to machine castings so hard that they would formerly have been rejected.

The lasting qualities of the tools, when not run at too high speeds, save many pieces from the scrap pile, because when the tools have once been set for machining a piece to the required dimensions, the size can be held longer without changing the tools. With tools that wear rapidly and frequently have to be taken out of the machine to be reground, a few pieces are usually lost at the beginning of the run, before the tools have been properly reset, and a few before regrinding, when the tools do not cut to size. This loss is avoided with cutting tools that keep their edges like the new tungsten-carbide tools. The saving in materials due to fewer parts being scrapped has been found in one plant, at least, to be more important than the savings in labor cost.

* * *

VALUE OF ENGINEERING MEETINGS

Many improvements in methods and equipment result from the ideas that an alert engineer obtains at engineering meetings. However, most engineers, being employes of firms or corporations, cannot attend such meetings without the approval of the executive in charge. Sometimes the executive, if he is not an engineer himself, does not fully appreciate the value of these meetings; but if the subjects to be discussed pertain to the work of the engineer who is to attend the meeting, his firm will undoubtedly benefit by the information that he obtains there. It would only be necessary for executives to attend engineering society meetings occasionally to become convinced of the value of the ideas that may be obtained from the papers and discussions.

Two papers recently read at an engineering meeting in New York may be mentioned in this connection. One related to the welding of jig frames, and the other to the cutting of metals by the gas flame. It is safe to say that no engineer or shop executive whose work relates to the design or construction of jigs and fixtures or the cutting of metal plates and structural shapes could possibly have left that meeting without carrying with him ideas of definite value to his company.

* * *

HANDLING MATERIALS EFFECTIVELY

Sometimes, in visiting shops where the machine tool equipment is of the best and the machining methods carefully planned and highly efficient, we find that the means of bringing the materials to the machines and of removing the finished parts are far from up to date. Much time is wasted in moving work from one part of the shop to the other. Old-fashioned trucks are slowly and laboriously pulled through the aisles, and often the aisles themselves are too narrow to permit the trucks to move freely.

Most manufacturers appreciate the value of up-to-date shop tools, but the handling of materials and parts is equally important, and the savings resulting from the use of first-class machine tool equipment should not be wasted through inefficient materials-handling methods.

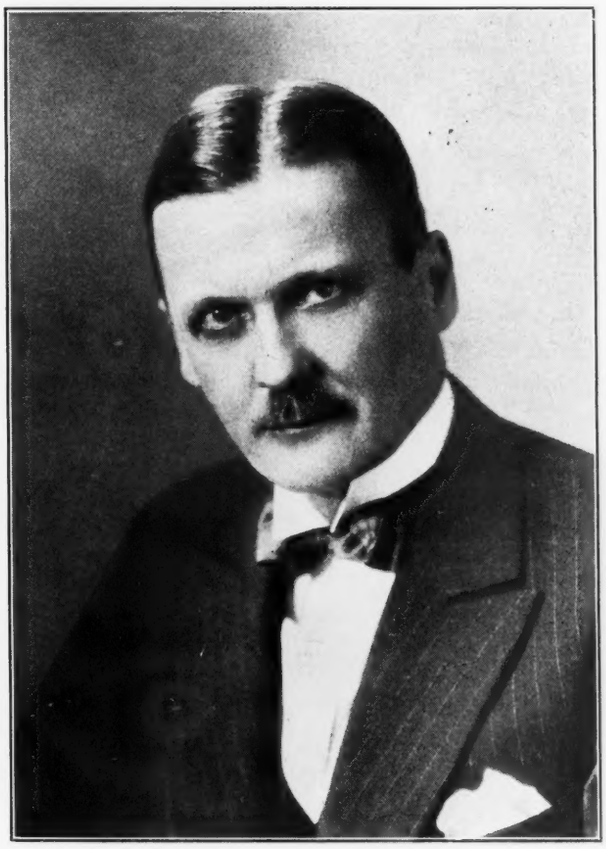
Building Up an Organization from Within

When Men Know that Vacancies will be Filled by Promotions from Within the Organization, They Prepare Themselves to Assume Responsibility

By ALFRED KAUFFMANN, President, Link-Belt Co., Chicago, Ill.

THE question has been asked of me whether I consider it more advantageous to the growth and permanent efficiency of an organization to promote employes to positions of greater responsibility or to obtain men with the required experience from the outside. Based on the experience of the Link-Belt Co., I would say definitely that I believe in promoting men from within an organization. This policy has been followed by this company in as far as it has been possible since its early days. The present chairman of the board of directors, Charles Piez, started as a draftsman with the company over forty years ago, and the writer also began in a similar capacity. A great many of our executives started with the company and have been promoted to their present responsible positions.

By promoting men from within your organization, you develop a spirit of loyalty and you encourage every man to do his best, because he feels that when the opportunity arises, he will have a chance for promotion.



Alfred Kauffmann, President, Link-Belt Co.

Along with the policy of promoting men from within the organization there must also be a policy of giving each man a chance to develop his latent abilities. He must be given responsibility and be permitted to carry this load of responsibility himself. He must be given a chance to use his own ideas and to produce results in his own way, conforming, of course, with the general policies of the concern.

When new ideas are to be carried out, assuming, of course, that the man with whom you deal is of the type that has shown capacity for further development and independent work, it is better to offer the idea as a suggestion rather than as an order, and to let the man work out the idea to a successful conclusion. In that way, he learns how to assume responsibility. Briefly, if a man shows that he is able to assume responsibility, let him assume it.

Taking an Inventory of Oneself

From the man's own point of view, it is very useful for him to take an inventory of himself once in awhile. He would do well to ask himself, "Do I fill my job as I would if I were engaged in my own business? Do I give it as much thought as I would if it were entirely my own? Do I take as much responsibility now as I would then? When a special problem comes up, how do I attack it—do I try to find the easiest way out, or do I do as I would do if all the responsibility were mine? If I were my own employer, would I be satisfied with the work I am doing? If I had a man working for me who did just what I am doing, would I consider him suitable for promotion?"

These questions, conscientiously answered, will help a man to get a true perspective of himself, and if he finds any shortcomings, he will be able to remedy them. It is likely that if he discovers shortcomings in himself, those in charge of his department have also discovered them.

It Usually Pays to Stay with a Successful Business

Generally speaking, the man who can make good elsewhere can also make good right with the firm where he is employed. If the firm is progressive, it generally is the best policy to stay with it, because in the course of years a man accumulates a great deal of experience and knowledge that is specialized and is of value only in his present connection. Much of the experience accumulated is lost in changing from one company to another. Of course, if a man is unhappy in his work or if he

obviously has the wrong kind of job, the best thing is to make a change and to obtain the kind of work that he likes, because no one can make a success in work that is distasteful to him. On the other hand, it is necessary to guard against being persuaded by restlessness that one is in the wrong kind of job.

The young man, especially, is a problem both to himself and to his employer. Frequently, he is unable to see far enough ahead to realize that his future is assured if he will await his opportunities patiently. Young men often expect too rapid promotion, and their point of view sometimes must be corrected by friendly advice.

If a concern has consistently followed the policy of promoting its men to positions of greater responsibility, this can be pointed out to those who are unable to see a future ahead of them. It is possible to show where the young men of yesterday are today. Frequently it is advisable to ask the young man who is impatient of his progress what jobs he believes himself competent to fill. When the responsibilities of these jobs are made clear to him, he may realize that he has not yet fitted himself to take on a bigger job. Ambition is praiseworthy, but everyone cannot expect to get to the top. There is no surer road to success than to take one step at a time and get a firm footing each time. The man who can do that is likely to climb quite high.

Credit is also Due the "Silent Worker"

Then there is also the man who recognizes his limitations and who fills well and ably the minor positions in an organization with contentment. He may be a "silent worker," but he fills a place that is just as necessary in the scheme of things as the positions that are in the limelight. He furnishes the solid foundation on which every successful business must be built. He is entitled to his share of the credit for the success attained. He has the satisfaction of feeling that he has done the job fitted to his abilities well, and that is as much of a satisfaction as any man has a right to take to himself, no matter how prominent a position he may occupy.

Efficiency and Application of Worm-gearing

In a paper read before the Yorkshire Branch of the Institution of Mechanical Engineers of Great Britain, H. E. Merritt of David Brown & Sons, Ltd., Huddersfield, England, mentioned that in a well designed, totally enclosed, properly lubricated worm reduction gear set an efficiency of 96 per cent may be expected, 97 per cent having been attained. Worm-gears transmitting 400 horsepower have been constructed with an efficiency of 96 per cent—equal to that of any other gear transmission. Designs have recently been developed for transmitting up to 3600 horsepower by means of worm-gears.

The best lubricant for worm-gearing is castor oil. While this oil tends to become thick in the course of time, on account of oxidation, this tendency can be prevented by adding from 5 to 10 per cent of mineral oil. If ordinary mineral oils are used for lubrication, it will be found that the heavy oils give more satisfactory service than the lighter ones. In totally enclosed and dust-proof gear-cases, there should be no deterioration of the oil. One such gear-case has been under observation for two years and the lubricant has not shown any sign of deterioration.

The coefficient of friction is a variable quantity. In a worm-gear drive having an efficiency of only 75 per cent, it may be as high as 0.2, but under the most ideal conditions, with 96 per cent efficiency, it may be as low as 0.02.

Experience has shown that the combination of a casehardened steel worm with a phosphor-bronze worm-wheel gives the most satisfactory results for worm-gearing. A phosphor-bronze containing 88 per cent of copper and from 11 to 12 per cent of tin gives good results. Manganese bronze has a higher coefficient of friction and is not so satisfactory for worm-wheels as phosphor-bronze.

For the worm, ordinary low-carbon casehardened steels should be used only for light or medium duty. For heavy duty, the best results are obtained from nickel casehardening steels. Nitralloy steel should also be employed only for light or medium duty, because the case is very thin and is likely to be worn off in heavy service. When the worm is integral with the shaft, it is customary to harden the worm thread only and not the whole worm-shaft.

The maximum running temperature for worm-gears is usually 160 degrees F., although gears are known to have run satisfactorily at temperatures up to 200 degrees F.

* * *

MANUFACTURERS ARE PUTTING THEIR HOUSES IN ORDER

After an extended trip covering the entire continent, during which he visited several of the leading manufacturing centers and interviewed some of the most prominent men in American industry, G. I. Ross, chief engineer of MacDonald Bros., Inc., Boston, Mass., says that leading manufacturers throughout the country show their confidence by the fact that a great number of them are now engaged in renovating their plants, redesigning their products, and inquiring into their manufacturing processes. "While it is true," he says, "that much of this work is being done in such a manner as to avoid large capital outlays, nevertheless, manufacturers are taking advantage of this breathing spell to put their houses in order. It is interesting to note how rapidly the average American manufacturer is putting his business on a scientific basis. Never before have manufacturers paid such close attention to the fundamental laws of management and engineering."

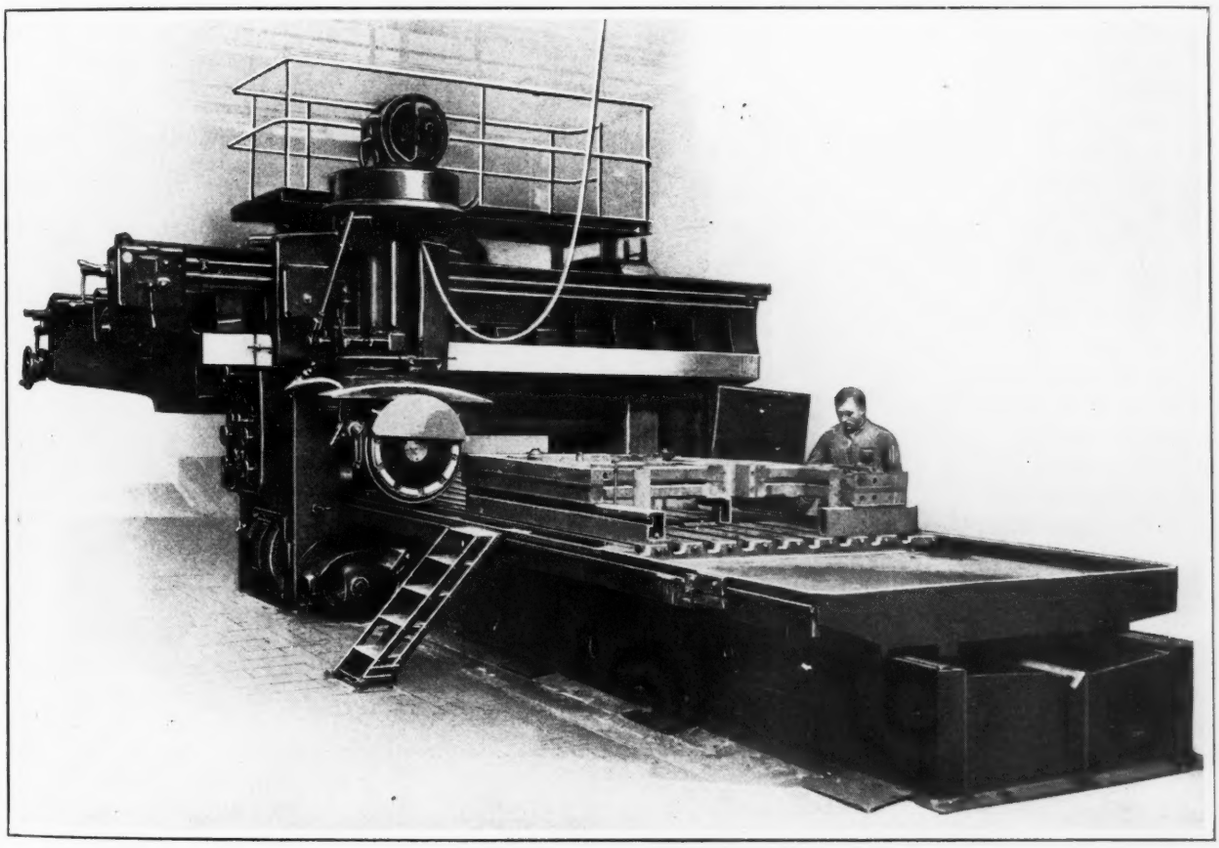
A German Grinding Machine of Unusual Size

Planer Type Machine Equipped with Two Grinding Heads that Permit Horizontal and Vertical Surfaces to be Ground at One Setting

By CURT WEIL

A GRINDING machine with a table having a working or setting surface 17 feet 2 inches long by 6 feet 7 inches wide has recently been built by the Naxos-Union, Frankfurt a/Main, Germany. The machine weighs 55 tons and has a working width between the posts of 8 feet 2 inches. The over-all length of the table is 28 feet 10 inches, and the length of the bed is 42 feet 6 inches.

A grinding wheel 19 1/2 inches in diameter by 5 3/4 inches wide is mounted on the headstock at the front of the post. This wheel is used for grinding horizontal surfaces and is covered by a steel casting guard to which a diamond tool-holder is attached for use in dressing the face of the wheel. A 30-horsepower variable-speed direct-current motor drives the wheel by means of a belt, providing



Large Planer Type Grinding Machine with Rear Cross-rail and Wheel-head for Grinding Vertical Surfaces at Right Angles with the Horizontal Surfaces Ground by the Wheel on the Front Cross-rail

A six-horsepower motor mounted at the lower end of the post drives the table by means of a worm and rack at speeds ranging from 10 feet 9 inches to 32 feet 10 inches per minute. The table slides on three guides or ways, the two outside ways being of the flat type, and the central way V-shaped. Reversal of the table is effected through the use of a magnetic clutch designed to eliminate shock and lessen the stresses imposed on the machine members. Several conveniently located switches permit the table to be stopped promptly by cutting off the current to the magnetic reversing clutch. Hand adjustment of the table is also provided.

cutting speeds from 69 to 105 feet per second.

Either hand or automatic in-feed is available, the automatic feed ranging from 0.0004 inch to 0.004 inch. The grinding wheel used for grinding vertical surfaces is 26 1/2 inches in diameter, and is mounted on the carriage on the rear cross-rail. This grinding wheel is driven by a 15-horsepower direct-current reversing motor. The head on which this wheel is mounted may be turned through an angle of 360 degrees. The carriage is moved along the cross-rail by a two-horsepower motor. A centrifugal pump driven by a 3/4-horsepower motor supplies cooling water.

Maintaining Precision in Production Lapping*

Flat or Cylindrical Parts Are Now Lapped by Machine to a Tolerance of 0.00002 Inch, Thus Obtaining Gage Accuracy at Low Cost

By SYDNEY PLAYER, Norton Co., Worcester, Mass.

IT is only within recent years that the development of lapping machines has advanced sufficiently to permit the finishing of surfaces to be done rapidly and economically, as well as accurately. Two classes of lapping machines in use today are of the vertical type, one employing cast-iron plates for laps and the other making use of abrasive lapping wheels.

The vertical lapping machine shown in Fig. 1 is designed primarily for cylindrical work, such as plug gages and other cylindrical shapes requiring great accuracy. The laps are made of soft, close-grained cast iron, the lower lap revolving at a speed of 60 revolutions per minute and running in a counter-clockwise direction. The upper lap does not revolve, but is free to float in a vertical direction, so that it rests on the work.

The lower lap is mounted on a hollow spindle driven by a worm and worm-wheel. Through this spindle passes a shaft driven by a train of gears from the spindle. This is called the "break-up shaft," and on its upper end is mounted a head having an adjustable slide carrying a drive pin which is eccentric with the spindle an amount sufficient to give a suitable movement to the work-holder shown in Fig. 3.

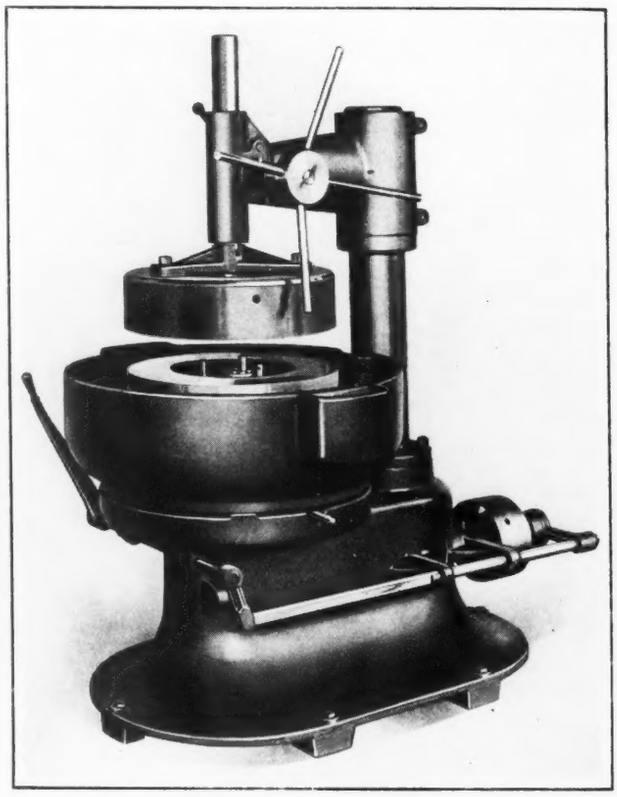


Fig. 1. Lapping Machine in which Cast-iron Laps are Employed

The holder has a bushing in its center and is free to turn on the eccentric drive pin. When the lower lap rotates, the work, between the stationary and rotating lap, carries the work-holder around the drive pin at about one-half the speed of the rotating lap. The eccentric drive pin is driven in the same direction, but at a different speed, and the combination of movements gives an ever changing position to the work relative to the faces of the laps. This action is what is meant by "break-up."

*Abstract of a paper read before the Machine Shop Practice Division of the American Society of Mechanical Engineers at Newark, N. J., March 20.

Machines for Lapping Flat Surfaces

The machines for lapping flat surfaces, such as gage-blocks, are similar to the one described, with the exception of the work-holder drive mechanism. This mechanism is arranged to impart a motion to the work similar to that produced in hand lapping. The lower lap is rotated on a hollow spindle by means of a worm and worm-gear.

Passing through the hollow spindle is a stationary shaft, to the upper end of which is fastened a gear—also stationary. A head, free to rotate, is mounted on this shaft and has three vertical studs on which are assembled three work-holder drive pinions which mesh with the stationary central gear. Enclosing the three drive pinions is a ring gear mounted on and driven by the hollow spindle. On the head of each pinion a vertical stud, eccentric with the pinion, enters three bushings in the work-holder. When the lower lap rotates, the ring gear revolves the pinions, which, in turn, impart the required motion to the work-holder by means of the eccentric studs. The ratio of the gears is such that the same relative movement of the work is obtained with both laps.

Types of Work-holders Used on Lapping Machines

The type of work-holder most commonly used for cylindrical work is shown in Fig. 3. It is known as a "leg spider," and consists mainly of a circular aluminum plate, in the periphery of which are drilled and reamed taper holes. The projected center lines of the holes are tangent to a circle of about 3 inches in diameter concentric with the center of the holder. In each hole is driven a spindle, the outer end having a straight diameter about 1/16 inch smaller than the hole in the work.

The cylinders are placed on these spindles and are free to revolve. Outside the ends of the cyl-

inders, and resting on four spindles which are longer than the rest, a ring is dropped, retaining the cylinders on their spindles. About 1/8 inch is allowed for end play for the cylinders, the latter bearing against thrust plates in the ring. This type of work-holder lends itself to rapid loading and unloading, although two holders are usually provided to eliminate any possible lost time. Moreover, the work-holder can be lifted on and off the machine completely loaded.

Holders used for flat work consist chiefly of circular steel plates bushed for the drive studs, and arranged with holes to suit the work to be lapped. This type of work-holder, shown in Fig. 4, stays on the machine. It is adjusted so that it touches neither of the laps, the work being placed in the holes.

Special Attention Must be Given to Care of Laps

The real secret of machine lapping is to have the surfaces of the laps in true planes. For precision work, they are planed and hand-scraped to a surface plate. Three laps are then worked together (this operation will be described later in connection with the preparation of new laps), using nothing coarser than the abrasive employed for the lapping operation. For ordinary work, however, the scraping operation can be eliminated and a fast cutting abrasive, such as silicon carbide used.

New laps are prepared by the following method before being assembled on the lapping machine: The working together is performed on a drill press, one lap being fastened to the table of the machine, and a second one resting on top of the first, the surfaces coming together with a film of oil containing an abrasive between them. From the spindle of the drill press extends a short crank, the crankpin of which enters a driving hole in the center of the upper lap; this upper lap is free to rotate and float about the crankpin. The drill press is set in slow motion, causing the upper lap to move in a path eccentric with the lower lap, while the upper lap rotates slowly about its own axis. The combination of these two motions has a tendency to produce lapping faces that match each other.

To obtain a true plane, three laps are used. They are numbered 1, 2, and 3, and are worked together in the following manner: 1 with 2, 1 with 3, 2 with 3, and so forth, as in producing master surface plates. Having obtained true surfaces, any subsequent dressing operations may be performed without removing the laps from the lapping machine, unless their surface has been destroyed.

This dressing is done by releasing the over-arm supporting the upper lap, allowing the latter to rest on the lower lap with a suitable abrasive and lubricant between the faces; and while the lower lap is rotated, the upper one is moved back and forth a short distance by hand across the surface of the lower lap.

Production Lapping Within a Limit of 0.00002 Inch

We will now consider the actual lapping operation. Assume that we have a number of steel cylinders to lap, 3 inches long, 1 inch in diameter, with a 1/2-inch hole through them. The finished size is to be 1 inch plus 0.0001 inch minus 0. The cylinders are finish-ground within limits of plus 0.0002 and plus 0.0004 inch. The cylinders are loaded on the work-holder and placed between the laps.

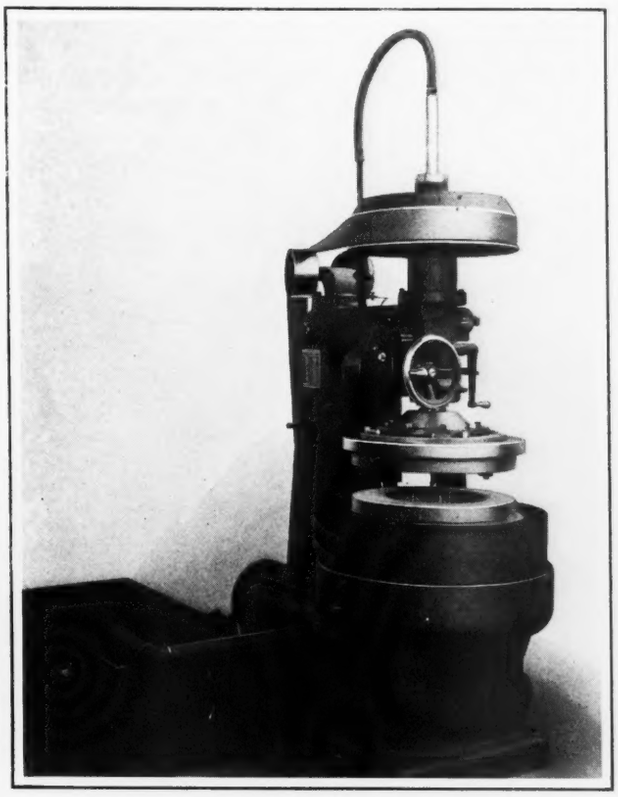


Fig. 2. Lapping Machine in which Abrasive Wheels are Employed

A fine abrasive consisting of dust fines and aluminous oxide abrasives mixed with kerosene and lard oil is applied with a brush in small amounts and the machine started. Between thirty and forty cylinders are lapped simultaneously for a few minutes, after which one is removed and measured. The time necessary to bring the first load down to size is carefully noted, and all subsequent loads are lapped for the same period. Thus if the grinding limits have been maintained, the entire lot will be lapped to uniform dimension within the limits of nominal size and plus 0.0001 inch. The same procedure is followed for lapping flat disks. The average production on the cylinders is about sixty to seventy per hour.

For precision lapping to very close tolerances, two operations are required. Assume that thirty plug gages are to be lapped to 0.875 inch diameter within limits of plus or minus 0.00002 inch. To lap to this close tolerance, it is better to hold the grinding to a closer limit than on the previous job. Good results have been obtained with grinding limits of plus 0.00015 and plus 0.0003 inch.

In this case, the laps used for both roughing and finishing must be prepared by hand-scraping. Great care must also be used in the dressing of these laps; when roughing, the same abrasive must be used to

dress as is used when lapping. It was found that M-304 American Optical emery is a good rougher and fairly fast in its cutting action, leaving a good surface for finishing.

The plug gages are lapped to within 0.00005 inch of the finished size in this roughing operation. The work is then rearranged in the work-holder by taking every alternate piece and placing it in a diametrically opposite position, thus mixing the larger and smaller diameters. By doing this three times during the course of the operation, true parallelism and uniformity are assured.

Having reached the stage for finishing, the gages are carefully washed without removing them from the holder and placed in the finishing machine. The laps on the finishing machine have been hand-scraped, and worked together with "levigated alumina" or jewelers' rouge until their surfaces have a mirror finish. The lapping of the gages is then continued without any further abrasive; a small amount of fine lubricant is used, however, to prevent the surfaces from drying. This method produces a mirror-like surface.

The time taken for the complete lapping of these thirty gages to the limits stated, is from two to three hours, the roughing only taking thirty minutes. The size blocks are lapped in the same way.

In the machine shown in Fig. 2, abrasive laps are used. These machines differ from those described in that they are much heavier, and abrasive bonded lapping wheels are used, revolving in different directions. For cylindrical lapping, the top lap runs at 99 revolutions per minute and the bottom lap at 113 revolutions per minute. For flat work, the same speed is used for the bottom lap, but a little different speed—103 revolutions per minute—for the top one. The upper lap runs clockwise, and the lower one counter-clockwise. In cylindrical lapping, the difference in speeds of the laps causes the work-holder to rotate about the eccentric drive pin; the combined movement thus given imparts the required "break-up." For dressing abrasive laps, a diamond dresser is used.

For rough-lapping, silicon carbide abrasive or vitrified aluminum oxide abrasive laps are used. For finishing, a very fine flour grain silicon carbide is used. Shellac bonded laps are used with good results. Lubricant is pumped to the work and laps from a large tank placed beside the machine. The lubricant consists of soap and water—lux being most commonly used.

Production on these machines is high—five hundred piston-pins per hour being lapped day after day, to limits of 0.0001 inch for straightness and roundness. The stock removed during roughing is 0.0002 to 0.0004 inch. For finishing, the stock removed ranges from 0 to 0.0002 inch over the high limit of the finished piece.

This type of machine can also be used successfully in lapping soft metal parts, such as piston-rings. When bonded abrasive laps are used, it is claimed that no charging takes place, as is the case when soft materials are lapped with cast-iron laps and loose abrasive. Several of these machines are in operation, lapping the wrist-pins of airplane motors. These pins are comparatively soft, and when lapped by this method a bright mirror surface results. When loose abrasive and cast-iron laps are used, the finish is dull gray.

Bonded abrasive lapping, however, must not be confused with grinding. Only the face of the wheel is used, the results showing no feed lines or traverse marks, but lines that are criss-crossed, giving a velvety "matt surface." A machine-lapped surface sliding on another part produces a minimum of friction and provides an efficient distribution of oil film. Consequently, machine-lapped parts, particularly those under great stress, will have a long life with little reduction in size due to wear, and there will be less noise and less risk of seizure.

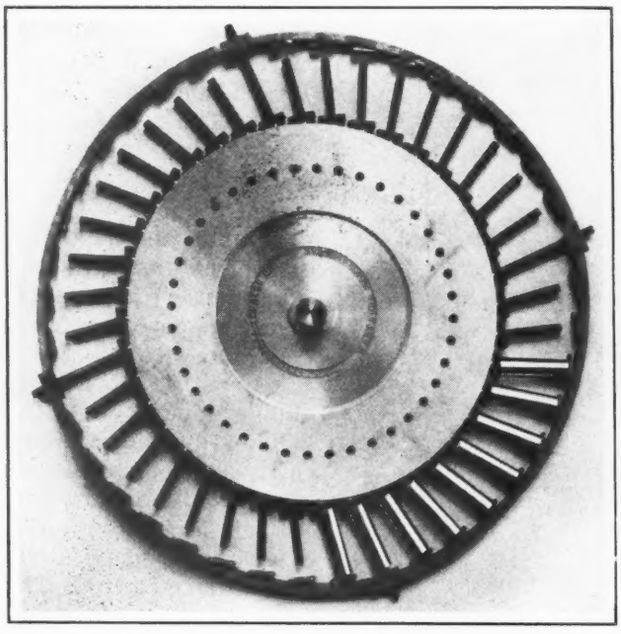


Fig. 3. Holder Used in Lapping Cylindrical Work

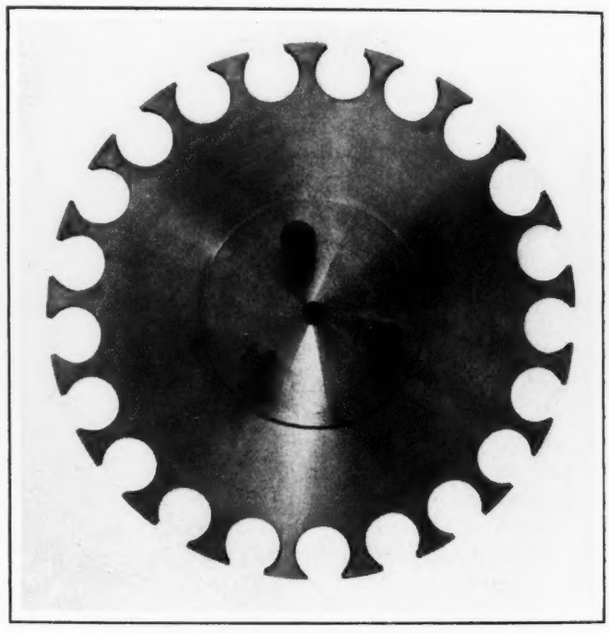


Fig. 4. Design of Holder Adapted for Flat Work

What MACHINERY'S Readers Think

A Department for the Interchange of Ideas on Problems of Management, Foremanship, and Employe Relations

KNOWING YOUR COSTS

Referring to the editorial on cost systems in April MACHINERY, I feel that the question of knowing one's costs is of the greatest importance to every manufacturer, large or small. When competition is very keen and a competitor sells at a low price, other manufacturers are likely to say that the one who undersells them does not know his costs. However, it is possible that he knows them exceptionally well, and for that very reason, is able to sell at a lower price than others in the field. If his overhead is low or if he can produce at lower costs through the use of highly efficient methods and equipment, and if he knows what it costs him, he may well be in a position to compete successfully.

It is a poor excuse for one unable to meet a competitor's price to say that the other firm's overhead is low. Low overhead is an indication of good management and is nothing to find fault with. Large plants that find it difficult to compete with small ones frequently offer the explanation that the overhead of the small plants is low or that they do not know their costs. It may be true that the small plants do not know their costs in many cases, and their overhead is almost always low; but if a large plant has built up such a superstructure that its overhead makes it difficult or impossible to compete successfully with a small plant, the remedy is not to increase the overhead of the small plant, but to pare down that of the large one. O. G.

AN EXPENSIVE BY-PRODUCT OF SPEED

The scrap heap has proved one of the most expensive by-products of too much speed, and it is interesting to note that some of the attention formerly concentrated on speeding up production is now being diverted to the problem of scrap reduction. There are many ways in which this can be accomplished. One is to make up a complete assembly of the machine or product before commencing production on the individual parts or units. This practice serves to check the accuracy of the drawings, and brings to light any unforeseen difficulties in machining or processing the parts.

Another method of reducing the scrap is to organize a salvage committee which can meet daily to investigate the cause of spoiled work. This should include representatives of the production, inspection, and engineering departments. Changes in design can often be worked out by this committee which will permit scrapped parts to be reworked. Besides adopting acceptable changes in design, the committee can often agree upon changes in tolerances and machining methods which may result in substantial savings. HARRY KAUFMAN

DISTRUST PRESENT METHODS

Commenting on the editorial in April MACHINERY on obsolete equipment, I believe that the best way for any manufacturer to make sure that he is using up-to-date methods and equipment is to distrust his present methods. He should question the value of the machines and processes being used in his plant and make a definite effort to find out whether they are the best ones available for the purpose or whether the market offers something better.

Old equipment is generally inefficient; it slows up production and is harmful alike to fair returns on investment and to wages. This is the penalty paid for the use of obsolete machinery. The loss is both individual and national; but it is not only old equipment that may be inefficient. New equipment may be unsatisfactory as well, unless it is carefully selected to suit the operations to be performed.

Recently I visited four shops and found the same conditions as those recorded by the Department of Commerce. In each of the four shops both the management and the foreman thought that they were using the best methods available for the work to be performed, but the cost of doing the work in the four shops showed a marked difference. In at least three of them the methods used were not the best that could have been employed.

OBSERVER

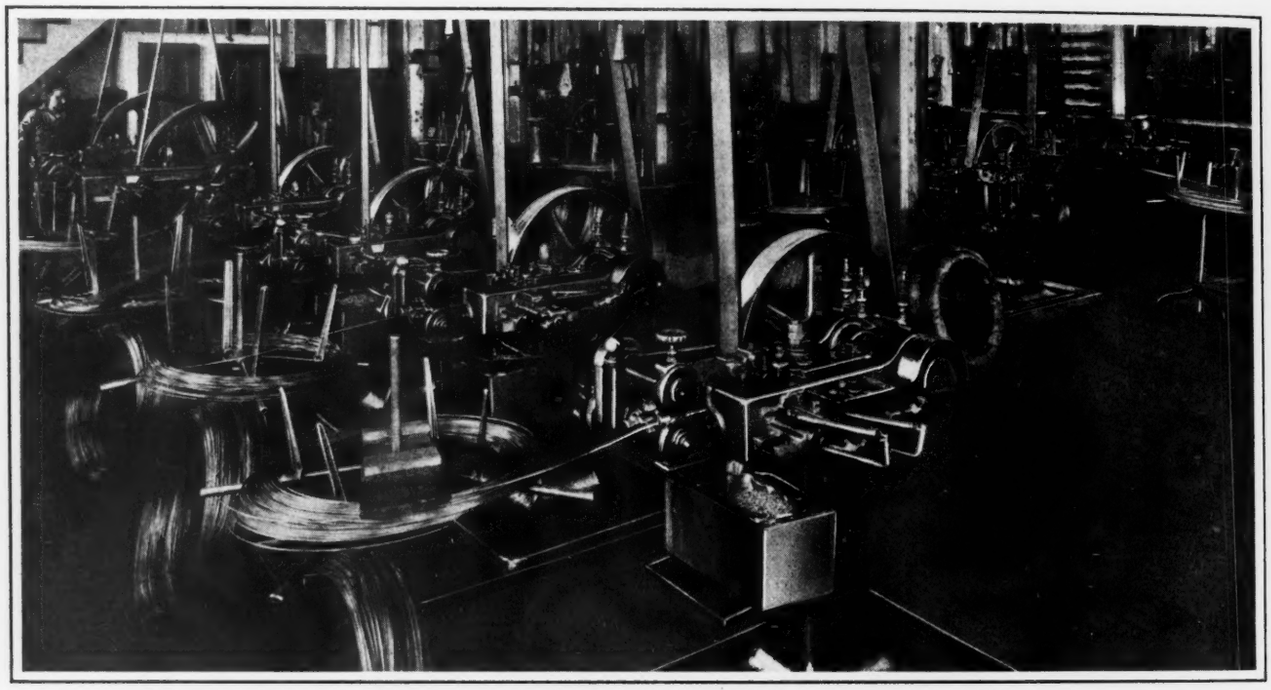
TRAINING AERONAUTICAL DRAFTSMEN

In training new men for airplane drafting, one company uses the following method: Each new man is assigned to one of the older draftsmen, the chief draftsman selecting a man who is quite familiar with aircraft in general and particularly with the company's drafting-room system. Then, to impress upon the new man the importance of the company's standards, he is asked to spend the first day reading them through. This is done more with the idea of creating a dependence on the standards than because it is expected that he will get a great deal of information out of it during the first day.

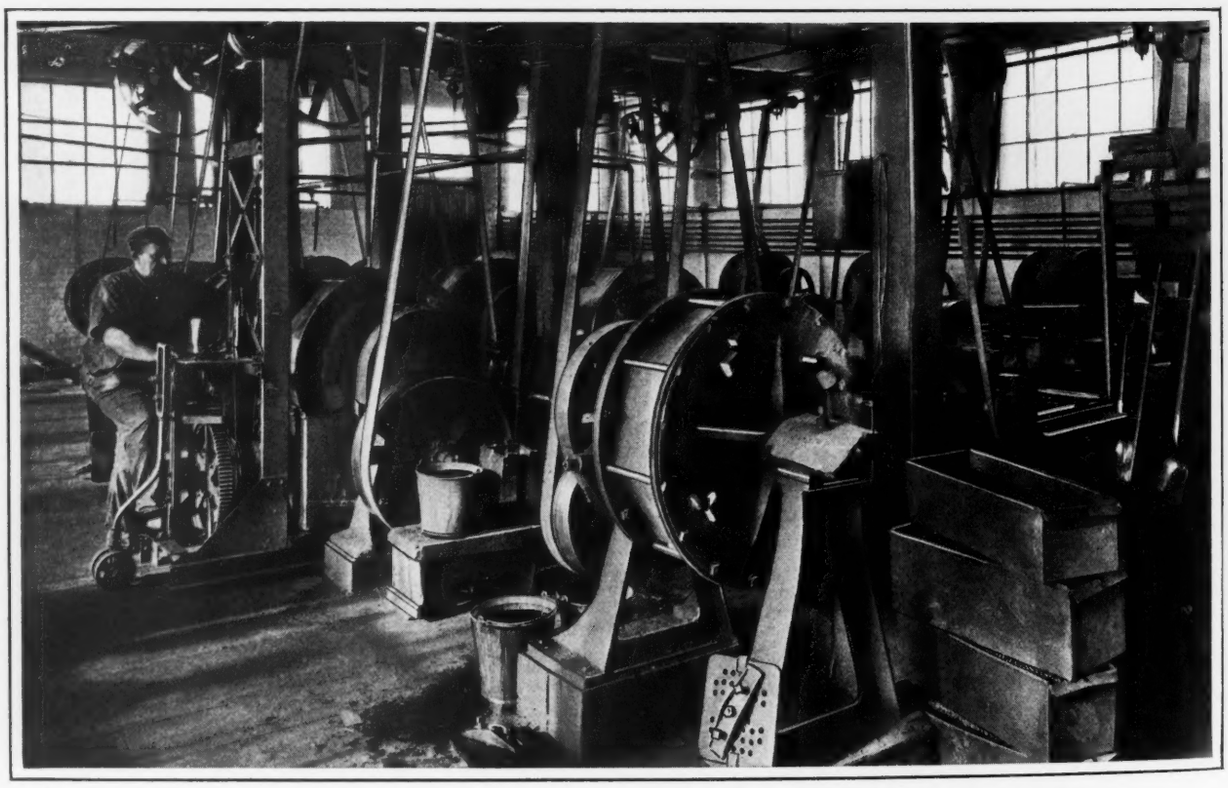
For a few weeks the new man's work consists mainly of making changes on drawings. This gives him as broad a survey of aircraft as possible, right from the start. The draftsman who has him in hand explains in detail why each change is made. The new man is then given work on detail drawings, still under the direction of the draftsman who has him in charge. Only after about six weeks does he begin to work directly under the man in charge of the department or division. In this manner, a new draftsman not familiar with aeronautical work acquires quickly a good understanding of the fundamentals. G. H. GUNN

Snapshots in a Steel Ball Making Plant

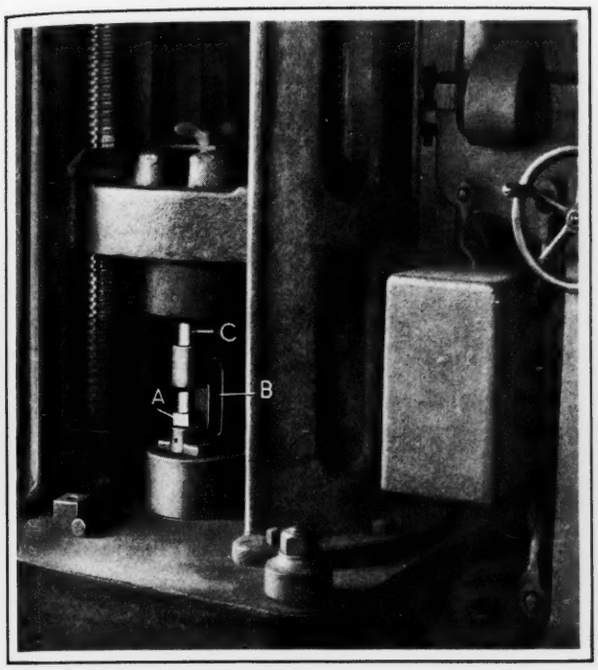
Typical Views in Different Departments of the Abbott Ball Co.'s Manufacturing Plant in Hartford, Conn.



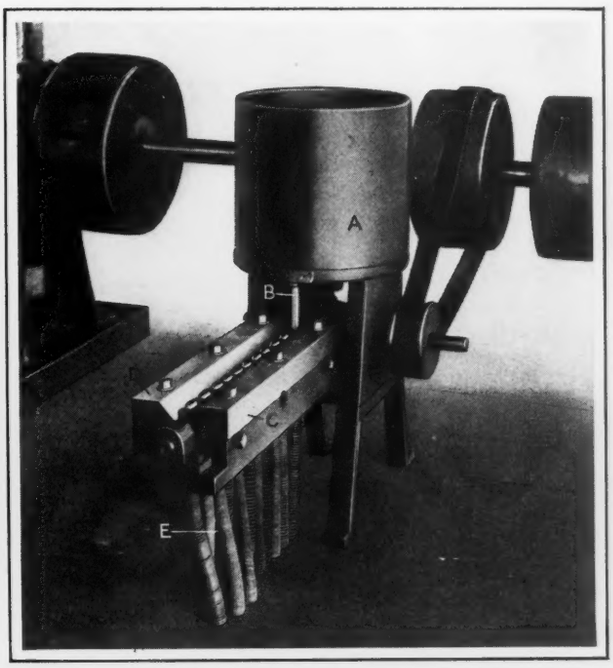
The Balls are Headed or Formed from Coiled Wire in Machines of the Type Shown Above



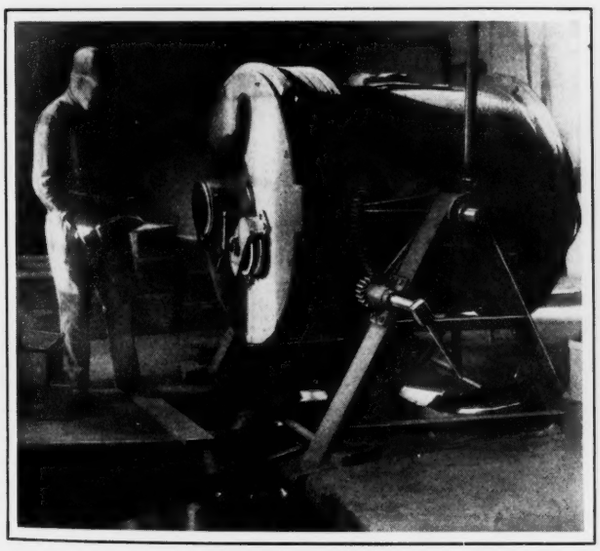
When the Steel Balls Come from the Heading Machines, They are Over Size. Tumbling Barrels are Employed to Reduce them to Approximately the Required Diameter



The Crushing Strength of the Balls is Tested in a 100,000-pound Riehle Machine. Three Balls are Placed One on Top of the Other in a Hole in Block A, Located on the Anvil of Holder B. Pressure is Exerted through Rod C



The Balls are Sorted to 0.0001-inch Variations in Size. Balls Placed in the Hopper A Pass One at a Time through Tube B and Roll Down the Slightly Tapered Way Formed by Bars C and D, Finally Dropping through Tubes E



A Rotary Oil-fired Furnace is Used for the Final Hardening of the Balls, which are Dumped Directly into the Quenching Tank by Tilting the Furnace

The Balls are Inspected for Surface Defects by Rolling Them Up and Down a Tilted Sheet of Glass. The Reflection from a Cardboard Shows Minute Defects

NATIONAL METAL EXPOSITION IN CHICAGO

In connection with the Twelfth Annual National Metal Exposition to be held at the Stevens Hotel in Chicago, September 22 to 26, under the auspices of the American Society for Steel Treating, a novel feature has been introduced for the convenience of the exhibitors. The booth rental includes the cost of cartage to and from the railroad terminals, the erection and dismantling of exhibits, the installations of gas, electricity, air, and water, as well as the cost of the current and gas used, the furniture, carpenter work, signs, and other charges that in the past were paid for separately by the exhibitor. The rental costs per square foot will vary with the requirements of each individual exhibition.

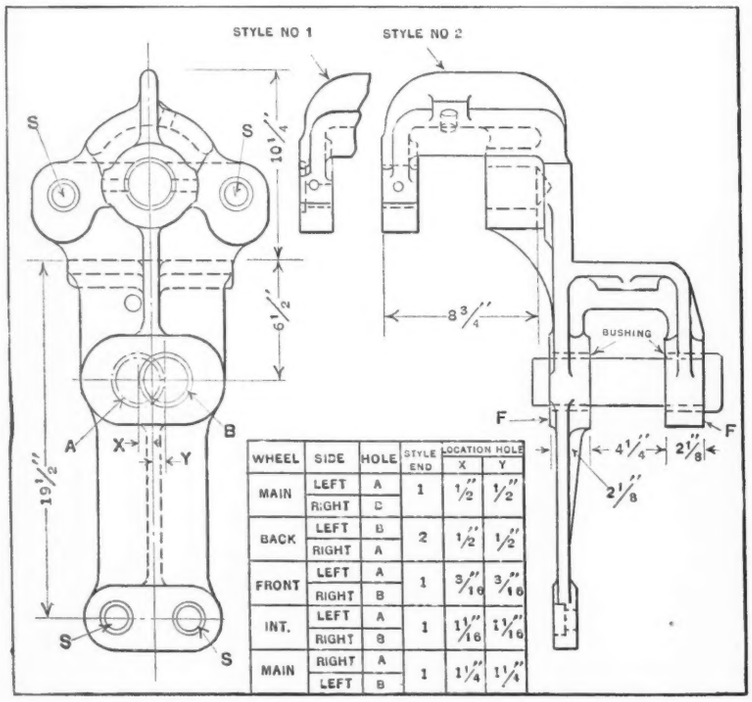
The exhibition will cover approximately 75,000 square feet of floor space, the facilities of the Stevens Hotel making it possible to stage a large industrial exhibition within the hotel. The technical sessions of the annual meeting of the Society will also be held in the hotel.

* * *

Two all arc-welded railroad bridges have been constructed up to the present time, and welding has also been partially used in the construction of four other bridges and railroad structures.

Special Tools and Devices for Railway Shops

Equipment Employed in Locomotive Repair Shops, Selected by Railway Shop Superintendents and Foremen as Good Examples of Labor-saving Devices



WHEEL	SIDE	HOLE	STYLE END	LOCATION HOLE X	LOCATION HOLE Y
MAIN	LEFT	A	1	½"	½"
	RIGHT	C			
BACK	LEFT	B	2	½"	½"
	RIGHT	A			
FRONT	LEFT	A	1	3/16"	3/16"
	RIGHT	B			
INT.	LEFT	A	1	1 1/16"	1 1/16"
	RIGHT	B			
MAIN	RIGHT	A	1	1¼"	1¼"
	LEFT	B			

Fig. 1. Locomotive Spring Equalizer Stand

EQUIPMENT FOR REBORING EQUALIZER STANDS

By J. H. HAHN, Portsmouth, Ohio

The portable equipment shown in Figs. 2 and 3 provides a convenient and efficient means of boring out worn holes in spring equalizer stands of locomotives that are undergoing repairs. Equalizer stands, one of which is shown in Fig. 1, are usually secured to the main frames by four bolts which pass through the holes *S*. The holes for pins of the spring equalizers, such as the one shown at *B*, become elongated through wear, and must be bored out and fitted with hardened steel bushings.

In order to remove the equalizer stands so that they can be rebored in the shop, it is necessary to take out the four fastening bolts. This is a rather troublesome job, and where large numbers of stands are to be rebored, the work becomes a source of considerable expense. The cost of handling this work can be greatly reduced, however, by using the equipment to be described, as it permits the stands to be rebored while in position on the locomotive frames. The spring equalizer pin holes shown in Fig. 1, which are designated *A* and *B*, are for stands used in different positions on the locomotive. For instance, one class of engine will have one "left back" equalizer with the hole positioned as indicated at *A*, while a "right back" equalizer will have the hole positioned as indicated at *B*, the center lines of these two holes being located on opposite sides of the center of the stand, as indicated by the dimensions *X* and *Y*, respectively. The location of the holes for different wheels is indicated by the table accompanying the illustration Fig. 1.

The boring-bar *C*, Fig. 3, is driven by an air motor *D*. The brass bushings *E* in the boring-bar bracket, Fig. 2, serve to guide the boring-bar. The bracket is clamped in place on the equalizer stand members *F* by bolts *H*. The extension feed-screw *J*, Fig. 3, is applied to the air motor in place of the regular feed-screw. The cutters *M* and *N*, Fig. 2, are fed through the two sides *F* of the work by the hand-operated nut *L*, Fig. 3. This feed-nut is held in place by means of the two clamping members *G*. The "old man" is clamped in position on the equalizer stand and supports the air motor while the boring operation, which finishes the holes in both sides of the stand, is being performed.

BORING FIXTURE FOR JOURNAL BRASSES

By H. H. HENSON

The fixtures shown at *A* and *B* in the illustration (see next page) are used for holding various locomotive parts on a horizontal boring mill. The work

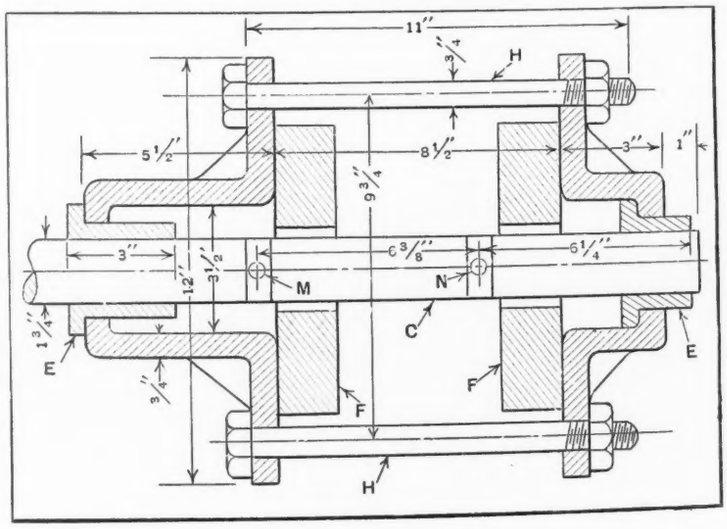


Fig. 2. Bracket Clamped to Equalizer Stand to Support and Align Boring Equipment

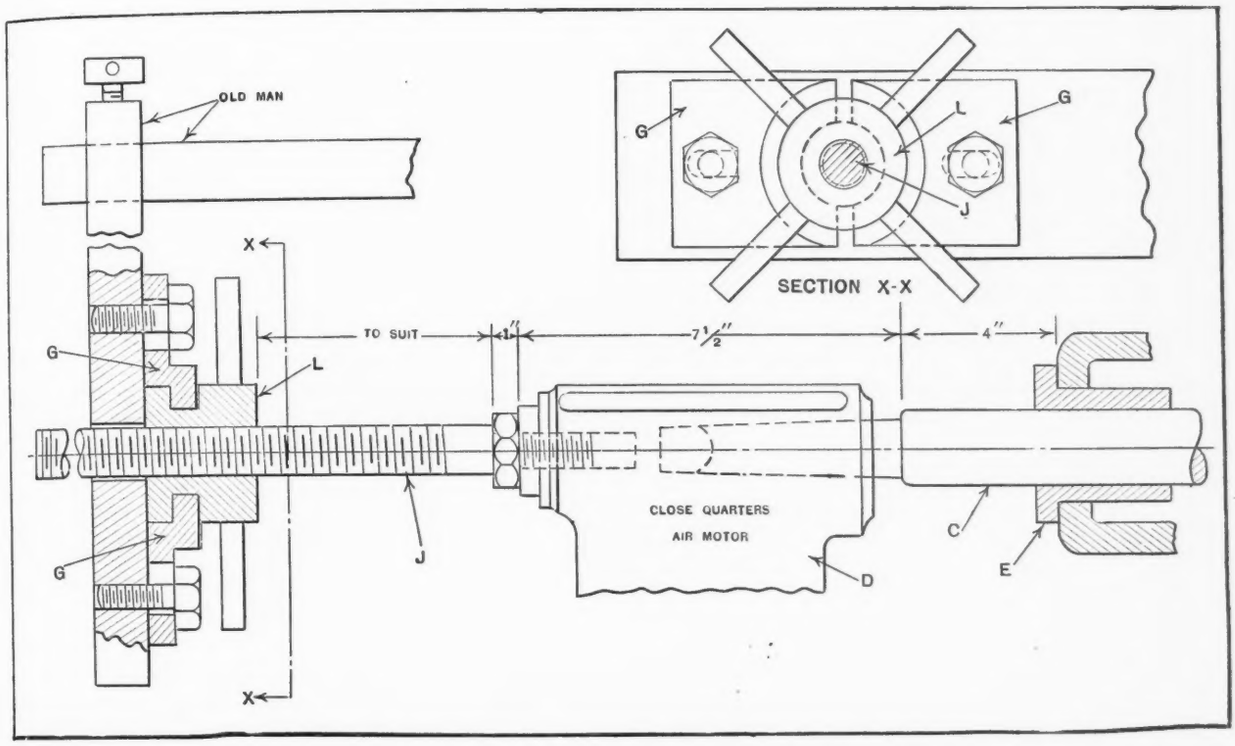
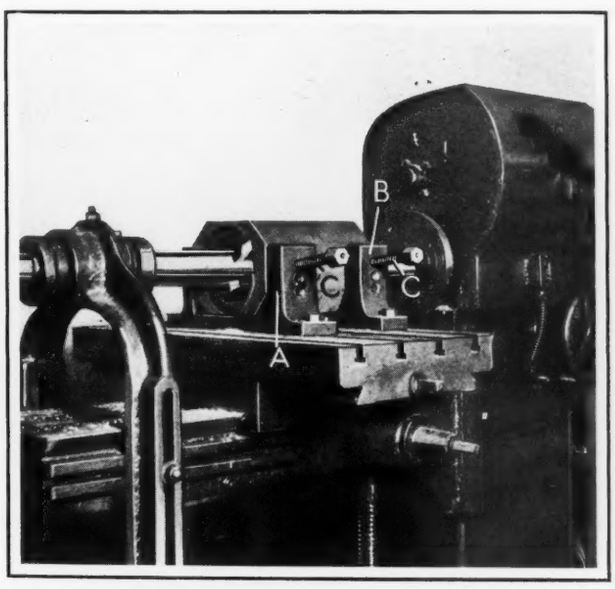


Fig. 3. Equipment for Driving and Feeding Boring-bar Used in Reboring Holes B, Fig. 1

regularly handled with these fixtures includes boring operations on such parts as trailing truck journal brasses, engine truck brasses, oil cellars, driving-box collars, and engine truck cellars. The fixtures are adjusted to suit the length of the work to be bored and are clamped to the table of the machine with bolts in the manner illustrated. The two fixtures are held parallel with each other by tongues in their bases, which fit the slots in the machine table.

The work is clamped in the fixtures by the conical pointed set-screws *C*. These screws are set at an angle so that they exert a downward pressure on the work. There are three holes for the set-screws in each of the four upright members of the fixtures between which the work is held. These holes are located at different heights from the bottom of the fixture in order to accommodate parts of different sizes. After adjusting the fixtures and the machine table for one job, any number of similar pieces may be lined up properly by simply loosening and tightening the set-screws *C*. This fixture has proved a great time- and labor-saver in the locomotive shop. It is of simple design and can be constructed at small cost.



Boring Mill Fixture for Railway Work

THE 1930 CENSUS OF MANUFACTURES

The census of manufactured products taken by the Bureau of Census, Washington, D. C., this year, covering production during 1929, will be more comprehensive in its scope than any previous census of manufactures. The results will be compiled first in preliminary reports, each of which will give information relating to one particular industry. These reports will cover in the aggregate thousands of classes of products, and each will be published within a few weeks after the receipt of complete returns from the industry covered. The preliminary statistics will compare the output for 1929 with that of 1927, the next previous year for which census figures have been compiled. These reports will show the ratio between cost of materials and value of products, output per wage earner, and ratio of wages to value of output.

If the preliminary reports are to be of the greatest value to manufacturers, they must be available within a reasonable time. This result will be brought about if manufacturers will cooperate with the Bureau of Census by making their returns promptly and by taking care to answer all questions applying to their plant correctly and completely.

A Successful Employes' Suggestion System

How a Large Corporation Enlisted the Cooperation of its Workers in an Effort to Eliminate Wasteful Methods and Inefficient Practices

ANNUAL savings estimated at over $250,000 were the direct result of a campaign for waste reduction described at the recent National Management Congress in Chicago by William B. Ferguson, Assistant to the president of the Newport News Shipbuilding & Dry Dock Co. A little over two years ago, this company started its first special campaign for waste reduction. The campaign was not a sudden outburst of enthusiasm, nor did it involve the application of any new principles or methods. It was merely the climax of various educational and cooperative movements based on the employes' representation or suggestion plan which had been put into effect several months previously. The results of the first campaign were so gratifying that a second campaign was conducted, with equally satisfactory results.

Savings Due to Adopted Suggestions Aggregated Large Sums

Out of 3000 suggestions submitted by the workers and supervisors in the first campaign, 677 were approved in whole or in part. These suggestions were gradually made effective during the following two years, resulting in an annual saving estimated at over $250,000. In the first campaign, efforts were made to create interest throughout the plant, attention being directed to a great variety of very small items on which savings seemed possible. This campaign probably cost the company $15,000.

During the following year, so many improvements were made as a result of the general interest created that there was naturally less opportunity for obtaining savings through a second campaign. However, the results of the second campaign were very gratifying. In this campaign, greater emphasis was placed on the quality of the suggestions than on the quantity. As a result, the ideas were given more thought before being suggested. The net savings resulting from the second campaign were estimated to be $100,000.

An analysis of the results of the first campaign is given in tabular form. Out of the 677 approved suggestions or recommendations presented, 308 came from wage earners and 369 from supervisors. In many cases, the same employe presented more than one good recommendation. In several instances, two or three people worked up a proposition together.

	Number Approved Suggestions	Estimated Annual Saving	Average Value
Extraordinary and novel ideas	21	$152,000	$7240
Unusually good ideas	46	53,000	1150
Very good ideas	40	13,000	325
Medium Savings	323	40,375	125
Small Savings	192	5,760	30
Very Small Savings	55	275	5
Grand Total	677	$264,410	$390

The approved suggestions were classified under forty headings, such as products, machinery, equipment, buildings, tools, materials, drafting, wage incentives, etc. The leading items or things about which some action was proposed were in the order named:

Classification	Number of Suggestions
Products	132
Materials	113
Equipment	95
Tools	48
Drafting	37
Direct Labor	31
Machinery	28

The total number of approved suggestions under the seven leading items was 484, or over 70 per cent of the grand total. It may be of interest to note that 27 good recommendations were made regarding the salvaging and reclaiming of materials.

After the results of the first campaign had been classified and studied, a special 32-page edition of the plant paper, *Shipyard Bulletin*, was issued. This proved of great interest and educational value to the employes. The names of the prize winners and their prize-winning suggestions were published. Altogether, there were 73 cash prizes awarded. Many of the suggestions were utilized in an educational way to secure better organization and training methods. This was accomplished by revising several manuals used by the company for the general instruction of employes.

The Value of Waste Elimination Efforts Cannot be Overestimated

In conclusion, it may be said that a special waste elimination campaign supplements and supports the usual management work to a great degree. Also, improvements can be inaugurated immediately, which could not possibly be introduced for several years without the educational work accomplished by the campaign.

The psychological and educational value of special campaigns such as those described should be stressed much more than the savings in dollars. If the management and the men in an industrial plant can meet on a common basis and exchange ideas for the mutual benefit of all concerned, then actual savings are bound to result as a by-product of their mutual interest and confidence.

Interesting facts and displays of actual cases of avoidable waste and other methods of advertising the campaign must be employed to create and maintain the interest necessary to insure the success of waste reduction campaigns. If anyone thinks such a campaign will succeed of its own accord, or without the wholehearted and enthusiastic support of all the higher officials and executives of a company, he is very much mistaken.

Threading a Screw Sixty-eight Feet Long

How a Hollow-spindle Lathe in Conjunction with a Special Indexing Device was Used for Threading an Unusually Long Screw

CUTTING a continuous thread along nearly the entire length of a screw 68 feet long, 6 5/16 inches in diameter, might be expected to present difficulties. Such screws are used on Sellers plate trimming machines. To purchase a lathe long enough to hold work of this length between centers would mean a large investment. Again, the floor space required by a machine of this size would be an objectionable feature, inasmuch as the lathe would be idle during certain periods.

The problem was successfully solved by installing a hollow-spindle lathe built by the Lodge & Shipley Machine Tool Co., Cincinnati, Ohio. On this machine one-half of the screw projects from the outer end of the spindle of the headstock, while the other end is supported by two steadyrests and the center in the tailstock, as shown in Fig. 1. The pitch of the thread on the screw is 1 1/4 inches, while the lead is 7 1/2 inches.

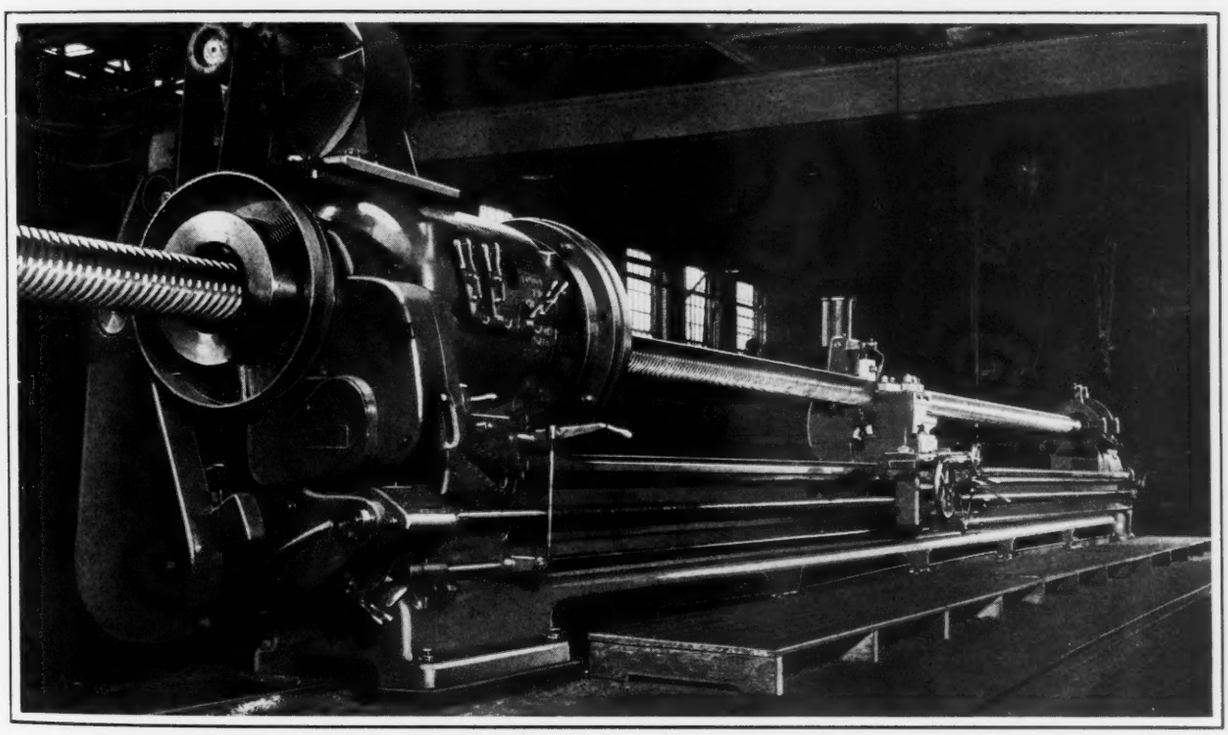


Fig. 1. Set-up in which a Screw 68 Feet Long is Threaded for Nearly its Entire Length

In order to cut the sextuple thread, the screw is secured in an indexing fixture fastened to the faceplate of the lathe. This fixture has six indexing positions, one for each thread on the screw. To chase this special lead, the lathe was provided with a coarse threading attachment. A special thread indicator was also furnished to enable the operator to pick up the leads for each successive cut.

As it is impossible to use a steadyrest—except near the tailstock—on the bed of the lathe, it was necessary to design a special follow-rest to support the heavy weight of the screw and to withstand the cutting pressure. This follow-rest, illustrated in Fig. 2, is fitted with three hardened steel jaws ground to fit the curvature of the screw. The surfaces of these jaws are made glass hard to prevent wear and scoring of the work.

The lathe is also equipped with a power rapid traverse for the return of the carriage. In the roughing operation, two threads are cut simultaneously to a depth of 3/8 inch, by two square-nosed tools 3/8 inch wide, properly spaced, thus reducing the number of cuts by one-half. After the first two threads have been roughed out, the fixture is indexed two positions, and two more threads are chased; the last two threads are then cut, the fixture being indexed in each case as already described. By roughing out the threads in this manner, much of the trouble due to springing of the stock is eliminated.

The cutting tools are next replaced by two similar tools, 1/4 inch wide, which are fed to a depth of about 3/4 inch. The third operation consists of roughing out the angular sides of the thread, the tools being made 1/16 inch smaller than the finishing tools. For the final cut, the threads are finished

separately with special angular tools which cut only on one side and at the bottom of the thread.

After one-half the screw has been finished, it is reversed, the finished portion extending from the headstock while the other part is threaded in a manner similar to that described.

* * *

A QUALITY DEPARTMENT

According to a paper read before a recent meeting of the Buffalo Section of the Society of Automotive Engineers by C. R. Nicodemus, assistant to the vice-president in charge of production of the Pierce-Arrow Motor Car Co., a quality department was recently created at the plant of this company, which has proved of great assistance in maintaining the highest possible degree of quality in the product of the plant.

All complaints, suggestions, and criticisms sent in by distributors or dealers, as well as all reports from the general inspection department, are checked over by a committee consisting of one specialist from each of the main departments of the plant. These specialists have nothing to do with either production or inspection; their function is strictly one of investigating difficulties and aiding in maintaining the quality of the product.

All complaints are then tabulated; in this way, it is possible to obtain a true picture of the quality of every unit or part of the car, and attention can be focussed on those production problems that most need attention. The corrections initiated by the quality department are passed through the inspection or engineering departments. If a change in design is required to correct some difficulty, the suggested change is first thoroughly investigated by the quality committee, and then checked by the engineering or inspection department before being put into effect. Thus every suggestion is scrutinized from different angles, and the final decision is likely to prove correct because it is not based on snap judgment.

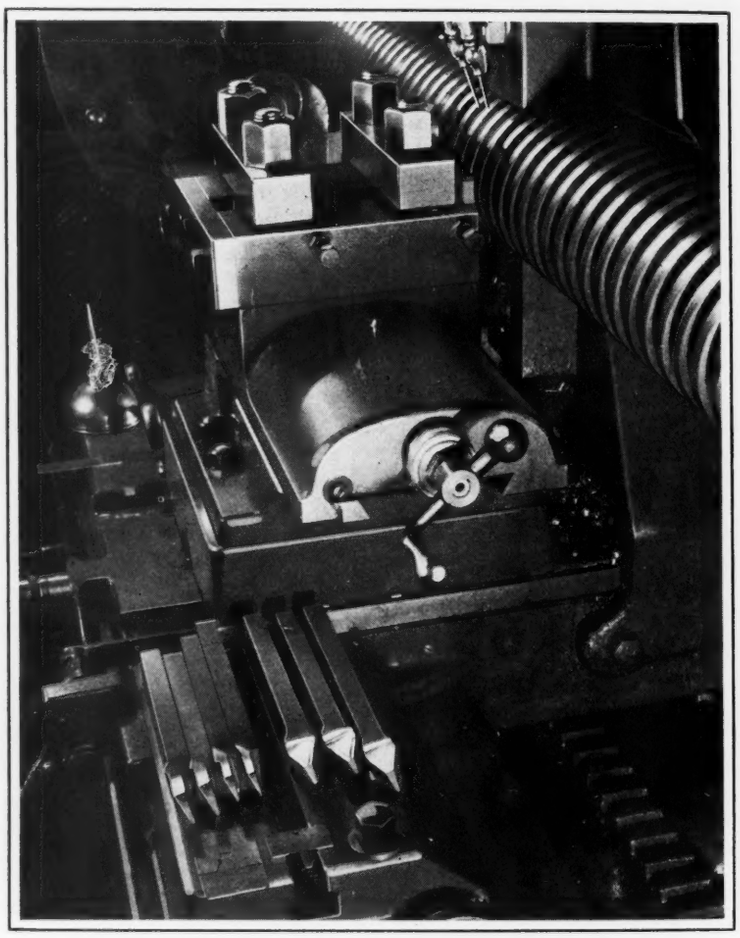


Fig. 2. Arrangement of Tool-slide and Follow-rest for Cutting Thread in the Lathe Shown in Fig. 1

CLEANING MOLDS BY THE WELDING BLOWPIPE FLAME

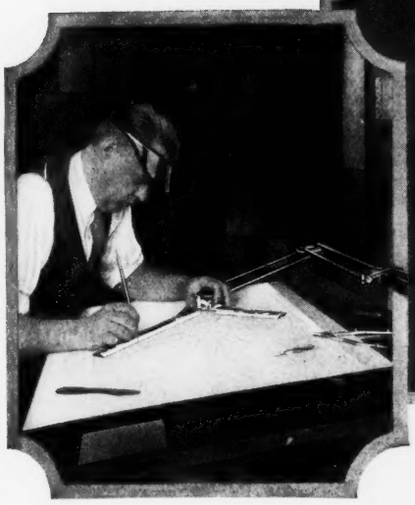
It is not generally known that the oxy-acetylene flame is used extensively in certain industries for cleaning molds of different kinds. The method was developed in the rubber industry, where it is common practice to remove the scale from automobile tire molds by playing an oxy-acetylene flame over them.

Tire molds are simply metal forms of the shape and size of the tire, with the inner surfaces shaped to correspond with the different tread markings. To prevent the tire from sticking to the wall of the mold at the high pressures and temperatures used in molding the rubber, the mold is dusted between each operation with ground soapstone or similar material. In spite of careful cleaning after each heating, a thin black scale gradually accumulates on the mold until a thorough cleaning becomes necessary. The cleaning method must not be so harsh that it will scratch, mar, or distort the interior surface.

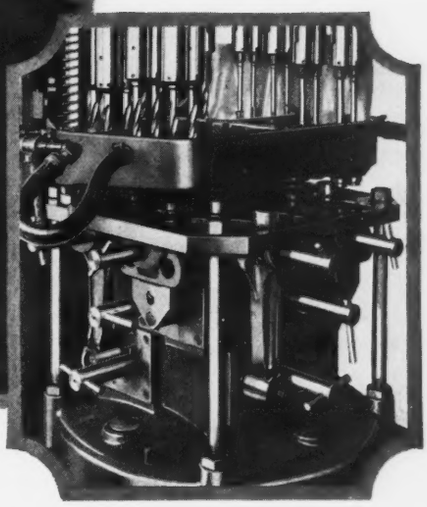
For a long time the practice in the rubber industry was to remove the scale by sand-blasting, using pulverized soapstone or clay as an abrasive. This method produced an excellent surface, but it was slow; cleaning one mold required two hours. Then it was found that playing a flame over the scale, to produce a temperature of 800 degrees F., would break it up quickly and completely. The oxy-acetylene welding blowpipe, since it provides a great amount of heat in a most convenient form, is the logical tool for this purpose. Through this use of the oxy-acetylene welding flame, the time required for cleaning molds has been reduced from two hours to fifteen minutes.

* * *

The longest direct air line in the world operating between Chicago and San Francisco is now equipped with twelve eighteen-passenger tri-motored airplanes, which carry mail and passengers between these points in twenty hours.



Design of Tools and Fixtures



COMBINATION TOOL FOR MACHINING PIPE FLANGES

By CHARLES C. TOMNEY, New Brunswick, N. J.

The accompanying illustration shows a combination tool for drilling, turning and facing pipe flanges in one operation. The object of the tool is to produce sharp edges without having to resort to a difficult grinding operation, which might be required if stepped blades were used. The cutting edges overlap in order to obtain the sharp edges required on the work. The tool is made for use in either a turret lathe or a drill press.

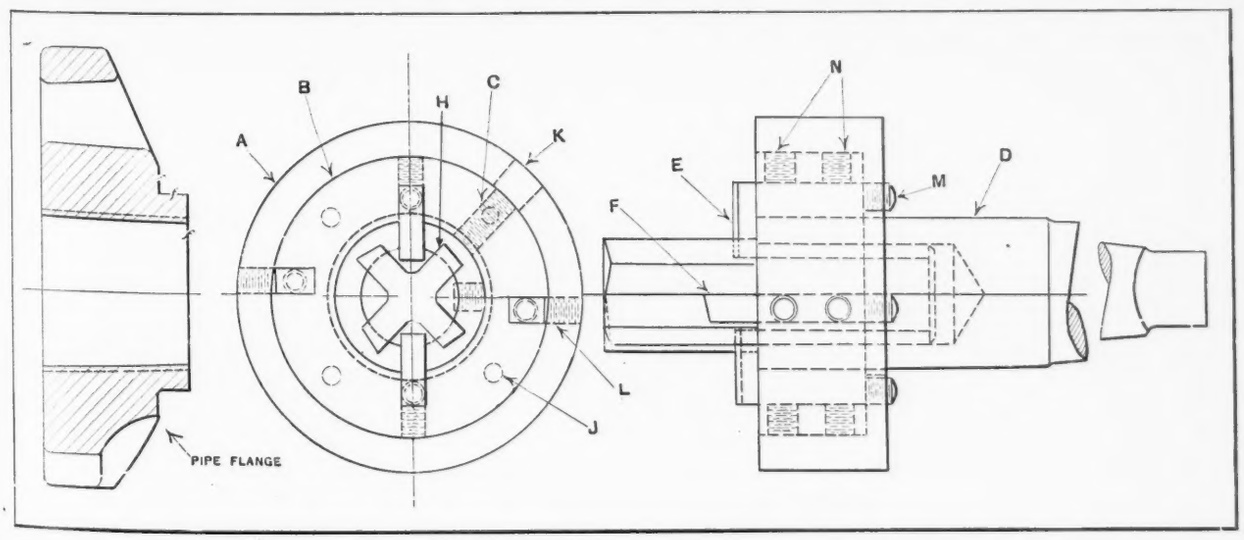
Referring to the illustration, the shank *D* is bored to receive the core drill *H*, one end of which has two grooves milled diametrically opposite each other. These grooves match with slots milled in the shank *D* and serve as nests for the facing blades *E*. The blades act as drivers for the core drill *H* and the cutter-head *B*. The core drill is held in shank *D* by a set-screw (not shown).

Cutter-head *B* is bored to fit shank *D* and slotted to receive the facing blade *E*, and the turning and facing blades *F*. The cutter-head is held in position by set-screw *C*. The grooves for blades *F* are milled off center so that the cutting edges will be on the center line. The outer sleeve *A* is cup shaped and is fastened to the cutter-head *B* by rivets *J*. Clearance hole *K* is provided in sleeve *A* for removing the set-screw *C*, while the set-screws *L* and *N* hold the turning and facing blades *E* and *F* in place. All the blades can be adjusted by set-screws *M*. After the turning and facing operations are completed, the flanges are rechucked and tapped for 1 1/2-inch pipe.

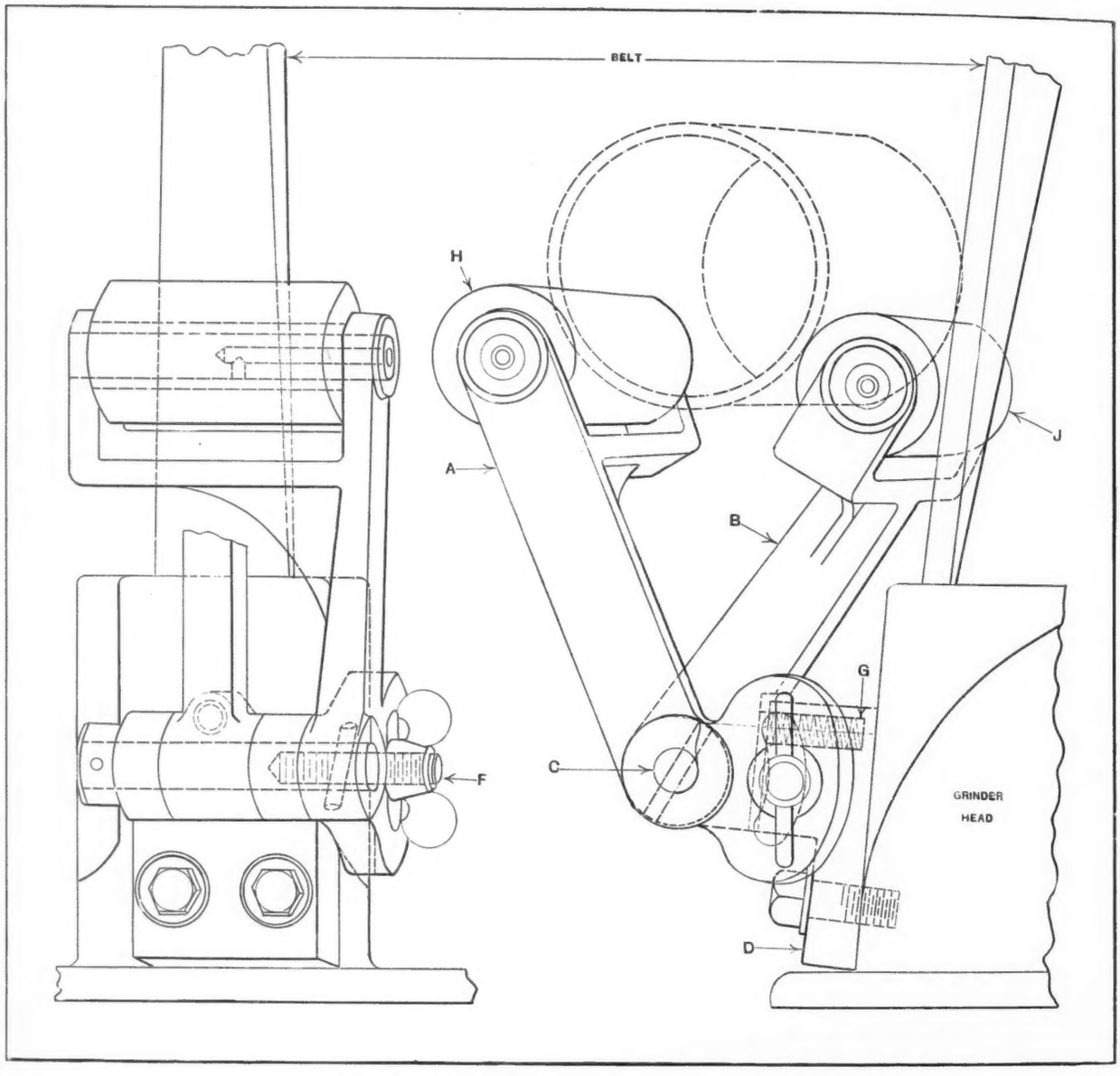
POLISHING ATTACHMENT FOR GRINDING MACHINE

By B. J. STERN, New York City

In the manufacture of hardened steel bushings and shells as carried on in one shop, the final operation consists of grinding the inner diameter. This is practically an automatic operation. The operator simply loads the chuck, starts the machine cycle, and unloads the chuck at the end of the cycle. On some lots of bushings it is necessary to polish the



Tool for Drilling, Facing, and Turning Pipe Flanges in One Operation



Grinding Machine Attachment for Polishing the Inside of Bushings

inner surface and stone the edges after grinding. This is done by the use of the fixture shown in the illustration.

This fixture is attached to the back of the grinder head so that the driving belt of the work-spindle also operates the fixture. The fixture consists essentially of two rocker arms *A* and *B*, both pivoted about the center of pin *C*, which turns in angle bracket *D*. This angle bracket is fastened to the back of the grinder head.

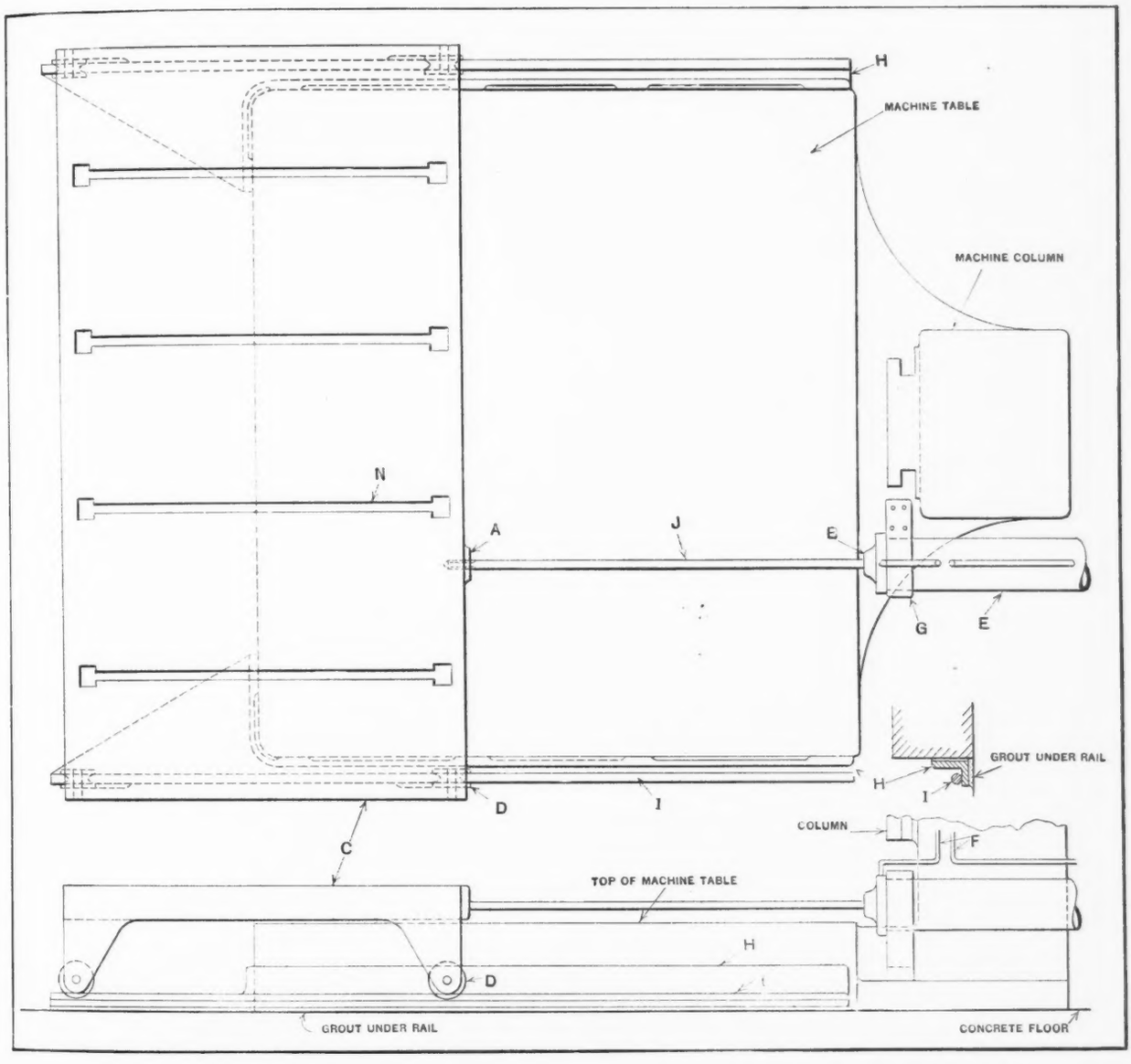
The arm *A*, doweled to pin *C*, is held in place by thumb-screw *F* and at the required angle with the rocker arm *B*. The latter is free to rotate on pin *C*, its own weight tending to throw it back toward the belt, which action is offset by the spring *G*. The two arms carry hardened and ground rollers *H* and *J*, the roller *J* resting against the driving belt only when the burring and polishing operation is taking place.

In operation, a bushing to be polished is placed in the cradle formed by the two rollers *H* and *J*. When the operator inserts the polishing stick in the bore of the bushing and presses down on the latter, the roller *J* will be forced against the driving belt, causing it to revolve. This roller also imparts a rotary motion to the bushing being polished. The polishing operation and the stoning of the edges are taking place while another bushing is being ground in the machine, thus turning some of the operator's idle time into useful work. A guard (not shown) is arranged to cover the driving belt in order to protect the operator.

AIR-OPERATED TABLE FOR MULTIPLE DRILLING MACHINE

By J. E. FENNO, Glen Ridge, N. J.

One of the most laborious jobs in the production department is the shifting of heavy work on the tables of multiple drilling machines. To facilitate this work, an air-operated table like that shown



Multiple Drilling Machine Equipped with an Air-operated Table to Facilitate the Handling of Work

diagrammatically in the illustration was built. On this table *C* are mounted four grooved rollers *D* which ride on the steel rails *I*. These rails are fastened by screws to the castings *H*, which, in turn, are bolted to the sides and front of the machine table and are grouted underneath with cement to support the weight of table *C*. Through the action of the air cylinder unit *E*, with its piston-rod *J* screwed into the table *C*, the latter is carried either out from under the multiple drill head or in position for drilling. The air cylinder is held securely at one end by the bracket *G*, which is bolted to the bed of the machine. The other end of the air cylinder is supported by a bracket leg, screwed to the concrete floor. The air pipes *F* are connected by flexible tubing to a three-way valve located on the multiple head in a position convenient for the operator.

To load the machine, the three-way air valve is turned on, admitting air to the right-hand side of the cylinder *E*, which causes the piston to move to the left and carry table *C* to the position shown. The work is placed on the table by a hoist, and located against suitable stops (not shown), which are fastened by bolts in the slots *N*. The valve lever is now swung over to permit air to enter the left side of the cylinder, causing table *C* and the work to move to the right until bosses *A* and *B*, which act as stops, come in contact. In this position, the work is drilled. If further drilling or tapping is to be done, table *C* can be quickly moved out to its loading position to permit the work to be shifted to another location.

INDEXING DIE FOR SLOTTING METAL CUP

By R. H. DAUTERICH, Baltimore, Md.

The accompanying illustrations show an indexing type of die employed in making a series of forty-five uniformly spaced slots in the metal cup shown at *A*, Fig. 1. This cup is part of a small automatic fire alarm device for household use. The slots are 5/32 inch wide and 5/8 inch long, and are rounded at both ends. The punch-holder *B*, Fig. 2,

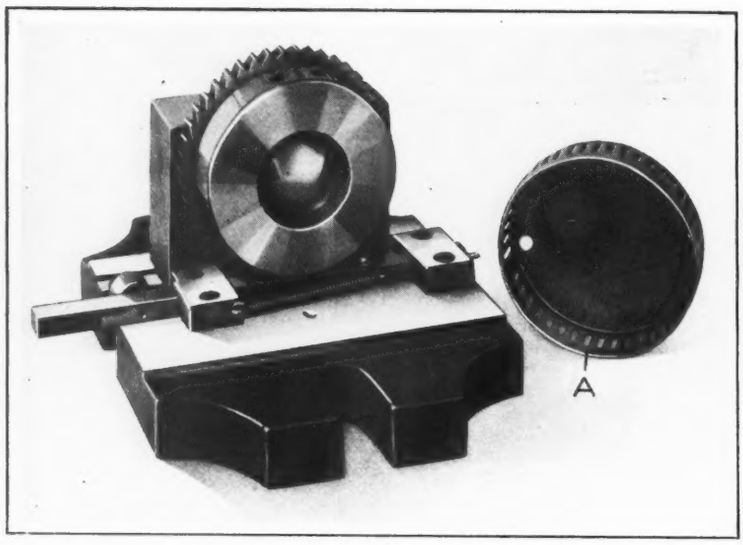


Fig. 1. Indexing Type of Slotting Die and Work Produced

is of simple design and carries only the piercing punch *C* and the cam bar *D* which operates the slide *E* through contact with the small hardened roller *F*.

On the downward stroke, the bar *D*, coming in contact with the roller *F*, indexes the work around one tooth space in an anti-clockwise direction and allows it to remain in a fixed position while the roll *F* is in contact with the straight portion of the bar. Continued downward movement causes the punch *C* to pierce one of the slots. On the upward stroke, the spring *G* returns bar *E* to its original position. The indexing and slotting operations are then repeated automatically at each stroke of the press.

The assembly of the mandrel, which holds the cup, and the die member is shown in section *X–X*, Fig. 2. The cups are held on the forty-five-tooth ratchet mandrel *H* by two small pins *I* which engage holes pierced on opposite sides of the work. The manner in which the pins and the flat springs to which they are attached are secured to the ratchet arbor is shown in the illustration. The die member *J* and the stud *K* are fixed, while the ratchet *H* is a close running fit on member *J*. The head of the stud *K* is cut away at the end, as shown in Fig. 1, to permit the punchings to fall through into the cup. The actual piercing is done in the hardened and ground insert *L*, Fig. 2, secured to the stationary die member *J* by two screws as shown.

COMBINATION MILLING FIXTURE AND GAGE FOR SETTING CUTTERS

By WILLIAM C. LANDIS, Wilmerding, Pa.

The milling fixture shown in the accompanying illustration is used for two straddle-milling operations on the same piece. The feature of particular interest is the hardened and ground gage-block *A* by which the cutters are set for the two operations.

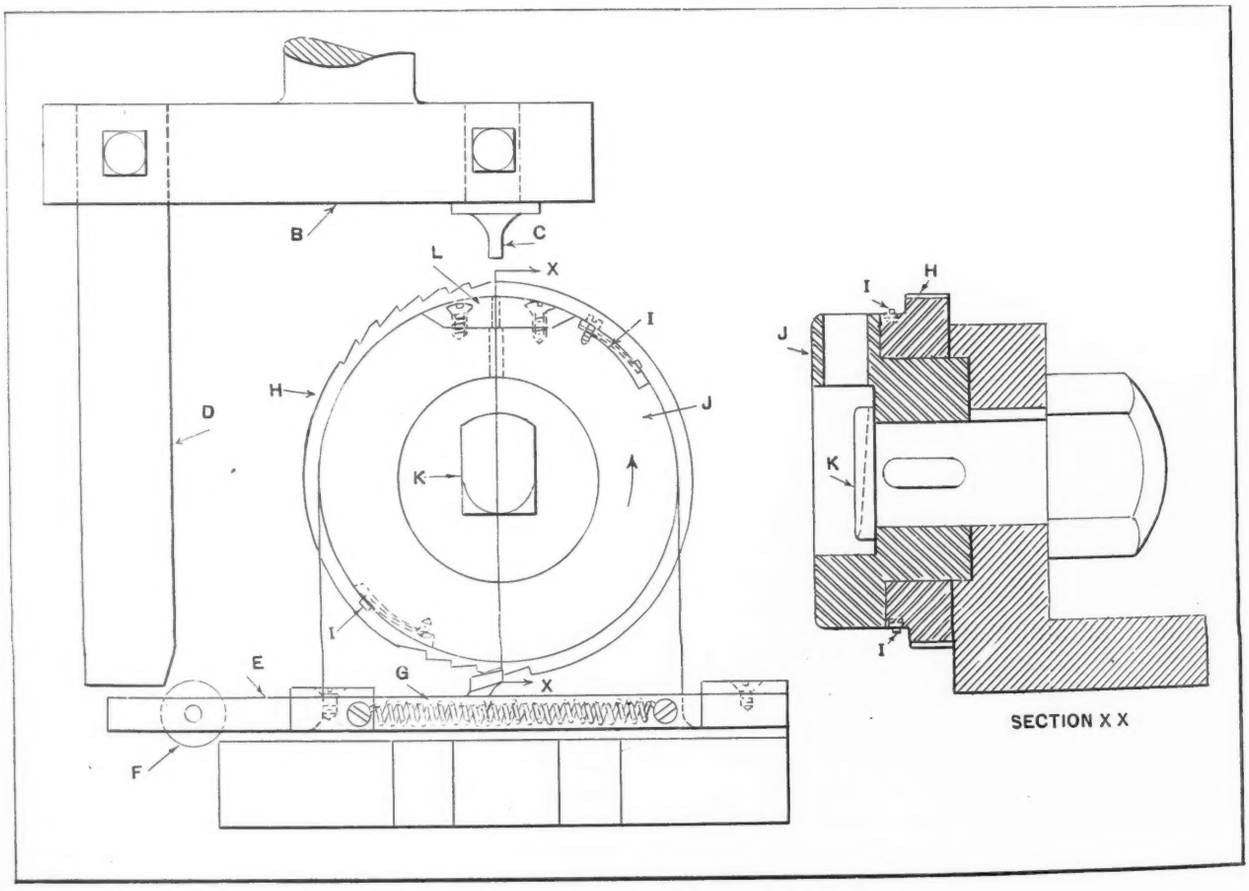
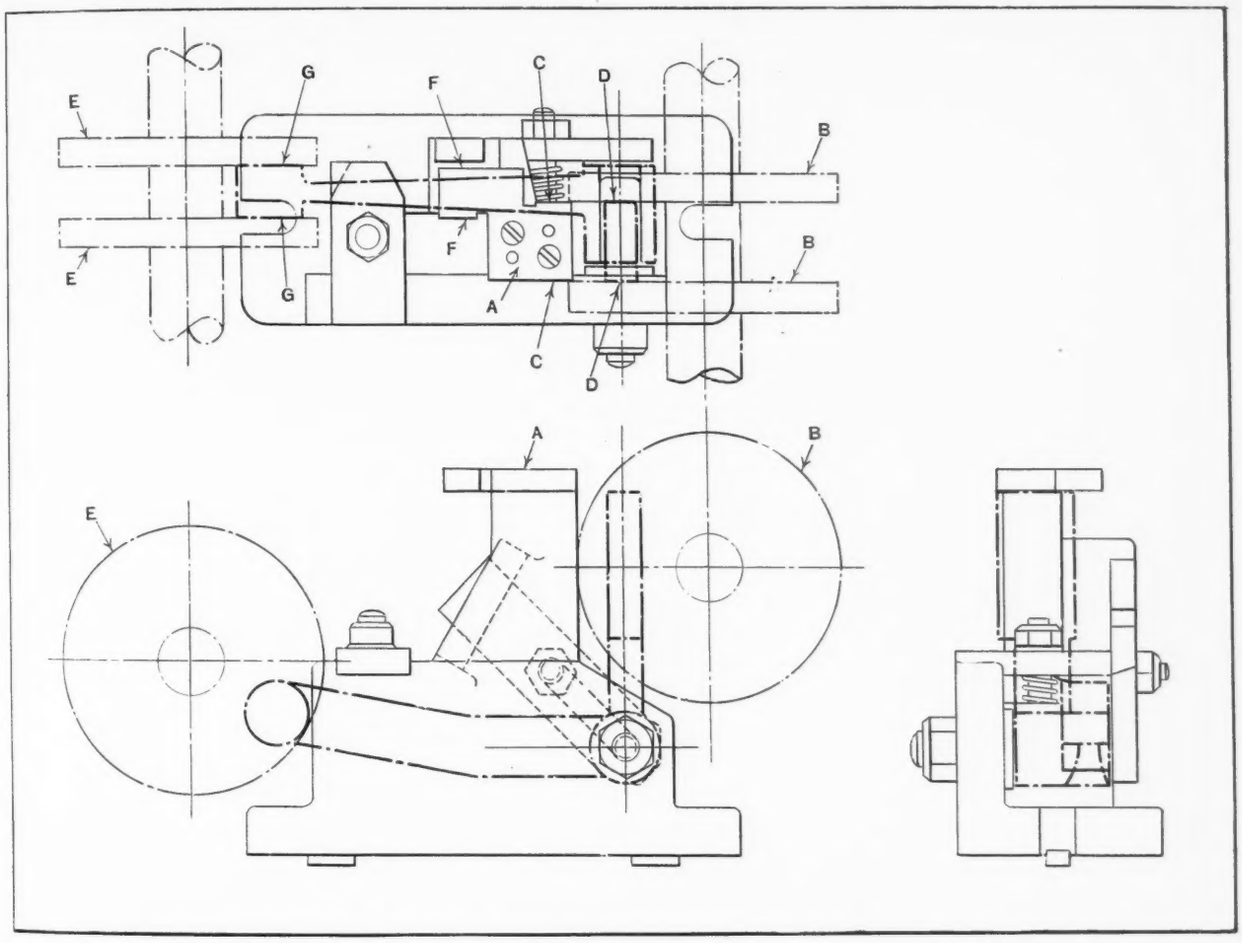


Fig. 2. Die Shown in Fig. 1 with the Punch in Place

The gage-block is permanently attached to the fixture. For the first operation, the cutters *B* are set by the faces *C* of the gage-block to mill surfaces *D* on the work. For the second operation, the cutters *E* are set to faces *F* of the gage-block for milling surfaces *G* on the work.

With this combination work-holder and tool-locating gage, the accuracy of the work is definitely established in the tool-room and is not susceptible to error each time the machine is set up. The fixture also permits the machine to be set up quickly. The principles embodied in the fixture have proved thoroughly practicable and they are applicable to fixtures for a variety of machining operations.



Milling Fixture with Fixed Gages for Setting Cutters

* * *

OFFICERS OF ELECTRIC HOIST ASSOCIATION

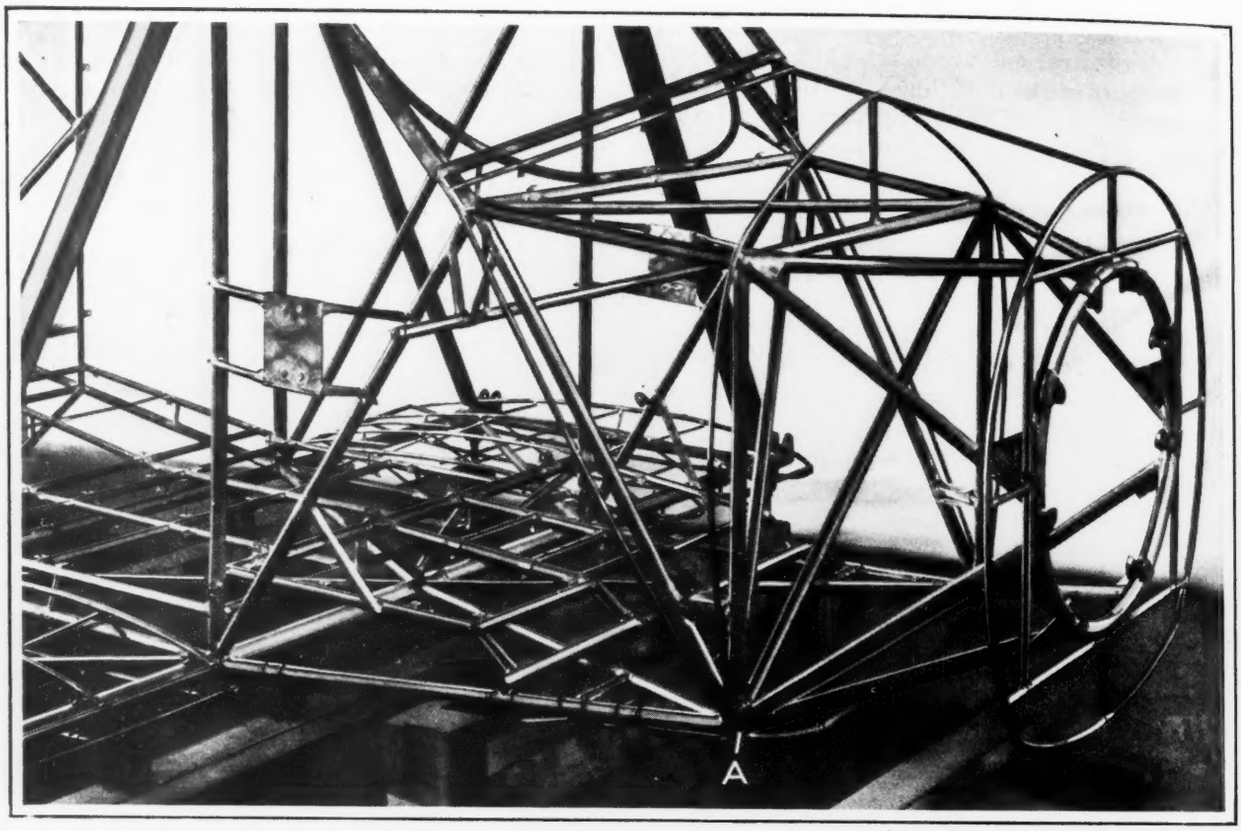
At the thirteenth annual meeting of the Electric Hoist Manufacturers' Association held at Pittsburgh, Pa., J. G. Worker, American Engineering Co., Philadelphia, Pa., was elected chairman of the Association for the coming year, and D. S. Brisbin, Chisholm-Moore Hoist Corporation, Tonawanda, N. Y., was elected vice-chairman. The Society has headquarters at 165 Broadway, New York City, with E. Donald Tolles, secretary-treasurer. The next meeting of the Society will be held May 22 at the Hotel McAlpin, New York City.

TESTS ON ARC-WELDED SPECIMENS

It has long been apparent that a weld having the same physical properties as rolled steel and that could be produced at a low cost would be highly desirable. In the past, welds of high tensile strength have been made, but usually at the sacrifice of ductility; the cost has also been high. Likewise, ductile welds have been made, but again at a high cost and usually at a sacrifice of tensile strength.

We are informed by the Lincoln Electric Co. that a series of tests has recently been conducted in the company's research laboratories at Cleveland, Ohio, which indicate new possibilities in regard to both ductility and strength of welds made at reasonable cost and with a speed satisfactory for commercial purposes. The welds tested were made by the so-called "electronic tornado" welding process.

Some of the welds tested were made at the rate of 45 lineal feet per side of welded plate per hour, or 22 1/2 feet of welded plate per hour, while others were made at the rate of 30 feet of welded plate per hour. The ultimate tensile strength of the welds tested all exceeded the maximum ultimate strength generally assumed for rolled steel and the elastic limit of the welds also exceeded that of rolled steel. The average of eight test pieces showed an elastic limit of 58,275 pounds per square inch and an ultimate strength of 78,287 pounds per square inch, with an average elongation of 21.25 per cent.



Constructing Fuselages for Airplanes

Properties and Proportions of the Tubing Used—Autogenous Welding Practice—Construction of Important Details

By E. F. LAKE

AIRPLANE building of the present day is largely a job for metal workers and requires a shop fairly well equipped with machine tools. In the early days, the "aeroplane," as it was then called, was constructed of bamboo or square wooden strips braced with wires. Only a few hand tools were needed for that kind of structure. This wood and wire design still clings to important parts like wings and their hinged ailerons. The trend of progress, however, is toward a metal structure for even these parts and that leads eventually to the all-metal airplane.

Materials Used in Fuselage Construction

The fuselage is the most important part of the airplane, as that is the body, or foundation, to which all other parts are attached. While the fuselage is sometimes made of duralumin, in the great majority of cases, it is made of steel tubing, and must meet the requirements of the Aeronautical Chamber of Commerce, which has established certain standards of strength for each unit of weight the plane is to carry.

Under the management of Herbert Hughes, the Buhl Aircraft Co., of Marysville, Mich., has developed the tubular fuselage to a high state of perfection for four-, six-, and eight-seat cabin airplanes for commercial use. In Fig. 1 is shown a completed fuselage for the six-place cabin ship. This is the same type of fuselage that was used in California in establishing an endurance record of over 274 hours of continuous flying, in a ship that had been in commercial use for a year and had previously flown more than 65,000 miles. The steel tubing in the fuselage is continually being vibrated by the engine while it is carrying the load, and that makes this a remarkable test for vibrational strains.

The total length of this fuselage is 25 feet 3 inches. Its width is 9 feet at the widest point and 44 inches on the outside of the cabin. The total height is 5 feet 2 inches. The illustration shows every tube and fitting in place for the mounting of all the other parts that go to make up the complete airplane. The weight of this fuselage is only 237 pounds, which is less than one-tenth of the 2430 pounds that the complete airplane weighs.

For each pound the ship can be reduced in weight, a pound can be added to the pay load it carries. Strength cannot be sacrificed, however,

as that would endanger the lives of passengers. Therefore, this weight factor is the greatest thing the aeronautical engineer has to contend with, and it is a bugaboo that has caused many sleepless nights.

Saving in Weight by Using Alloy Steel

The alloy steels seem to give the best results as regards the conditions just outlined, and the fuselage in Fig. 1 is made entirely of chrome-molybdenum steel tubing. Not a bolt or rivet is used to hold any part of the fuselage together. Every joint is welded by the oxy-acetylene process, and only high-grade welders can be used on this work. Gussets and reinforcements are also welded on whenever needed. That makes the entire fuselage practically one piece of steel. All joints must have air-tight welds, and tube ends are sealed up so that no moisture can get inside of the tubing and cause rust or corrosion.

To produce a fuselage of the same strength with the best grade of carbon steel tubing would necessitate a weight of about 400 pounds, as against the present weight of 237 pounds. Hence, carbon steel would reduce the pay load 163 pounds. For this reason, the extra first cost of alloy steel is soon paid for. Carbon steel tubing has a tensile strength of 55,000 pounds per square inch and a yield point of 36,000 pounds. Chrome-molybdenum steel tubing has a tensile strength of 95,000 pounds and a yield point of 60,000 pounds per square inch. Thus, one can readily see how much weight can be saved by using the alloy steel.

If ways and means could be devised of heat-treating as large a thing as a fuselage economically after welding, the weight might still further be reduced; but if the tubing were heat-treated prior to assembling, the effect would be destroyed at the joints when the tubes were welded together. Considerable weight could also be saved if the engineer were assured that the pilot would always hit the ground easily when he came down. The hard bumps which the airplane receives in landing require much more strength in a fuselage than any strains it is subjected to under flying conditions.

Strength and Toughness

That these fuselages have enough strength is shown by the fact that they have never broken or bent, except in a crash that wrecked other parts of the airplane. As mentioned, fuselages are continually subjected to vibrations set up by the engine. In addition, they get sudden shocks when the ship hits the ground in landing and harder vibrations when it runs over the rough landing field; therefore, the metals that go into a fuselage must have a resistance to vibrational strains rather than to a straight tensile pull. This requires the "hard toughness" (this term is used in contrast to the "soft toughness" of copper) that is found in alloy steels to a much greater extent than in carbon steels. Several alloy steels resist vibrational strains four and six times longer than the carbon steels, and none of the non-ferrous metals are close enough to be interesting.

Chromium reduces the grain structure in steel and makes the metal exceptionally fine grained and hard; but it has a tendency to produce a mineral hardness unless other elements that will neutralize this are present in the steel. Molybdenum, in the

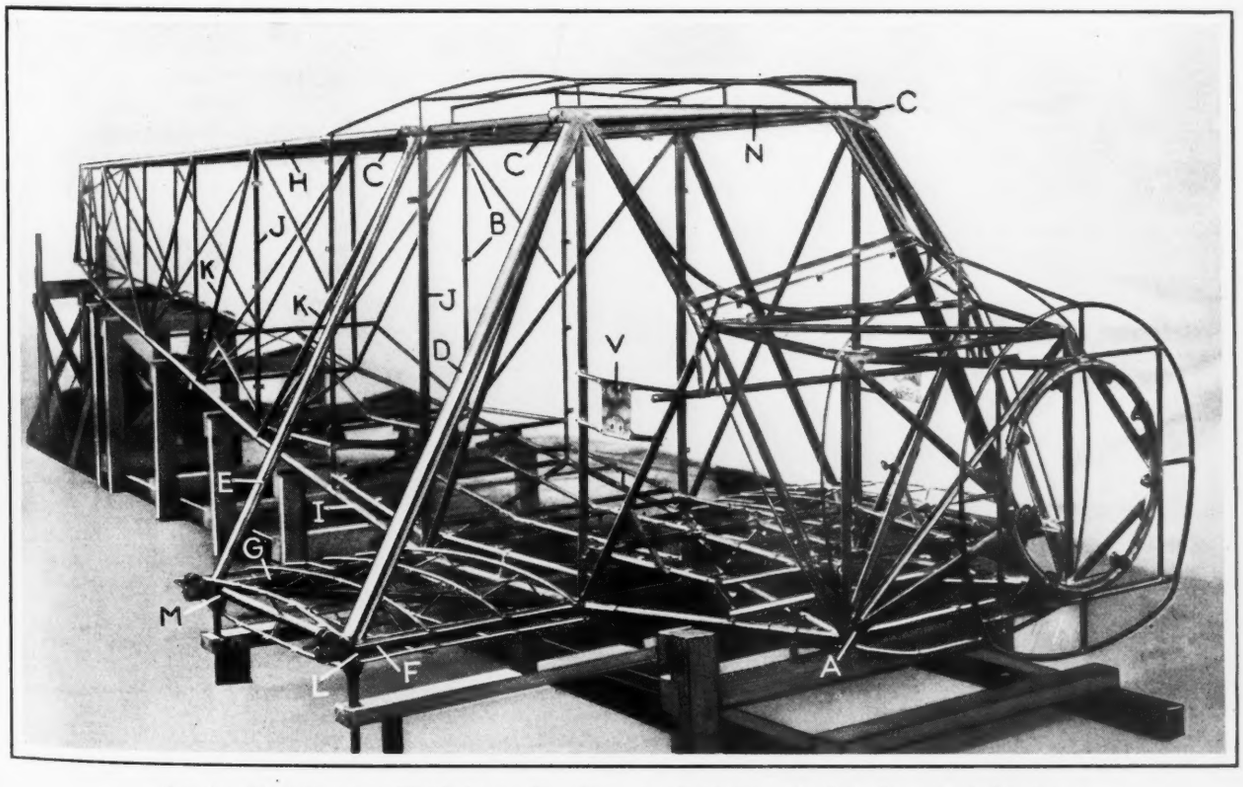


Fig. 1. Steel Fuselage Welded into One Piece for Buhl Aircraft Co.'s Six-seated Airplane

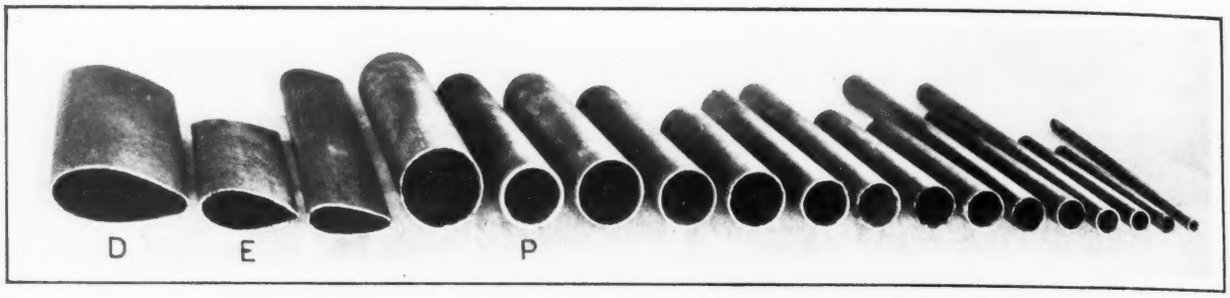


Fig. 2. The Different Tube Sizes Used in Fuselage Shown in Fig. 1

small percentages used, reduces any mineral hardness that chromium might impart and produces a hard toughness that is especially resistant to vibratory or torsional strains. It also makes the steel more easily machineable and weldable.

The powerful effect produced on steel by less than one per cent of molybdenum is one of the peculiarities of metallurgy. In larger percentages it has been used as an alloying element for several decades without obtaining any results that were worth while, and tungsten proved superior as an alloy for high-speed steel. Then percentages were reduced to from one-quarter of one per cent up to one per cent, and comparatively wonderful results were obtained when it was used in combination with other alloying elements. Chromium took the opposite course. In combination with nickel, it produced one of our first alloy steels, and was used for some two decades in varying amounts up to 6 per cent. This was thought to be its top range of usefulness, when someone doubled the dose and in the chromium range of from 12 to 15 per cent discovered our very useful steels that will not rust or corrode. Before that, rustless steels were considered an impossibility.

Factors which Affect Welding

High-range chromium steels cannot be welded with the oxy-acetylene torch, but the chrome-molybdenum steel tubing used in the fuselage described can be given a smooth, strong weld by a skilled welder who will *weld* the joints instead of burning them together. It is much easier to burn this steel with the oxy-acetylene torch than it is the carbon steels.

To get good welds, the torch flame must have the correct temperature; the oxygen and acetylene (or carbon) must be in the right proportions to produce an absolutely neutral flame; the welding rod must show the correct chemical analyses and the welder must work fast enough. Otherwise the metal under the torch flame will boil up, bubble, burn, and leave blisters. The writer has broken up some welded joints that snapped as easily as a piece of glass and with the same crackle. Such a result was due to an excess of carbon in the torch flame and a low-temperature flame. This would cause a slow melting of the steel for the weld and give the excess carbon time to soak into the steel and produce a very high carbon content at the weld. The color of the steel where it broke was an indication of this condition.

On the other hand, a welding flame with too much oxygen might blow this into the molten steel at the weld and honeycomb it with microscopic gas bubbles. This would weaken the steel at the weld but would not be likely to reduce its toughness at the points surrounding such bubbles. It would not alter the color of the steel as would an excess of carbon, which if high enough would make it look like cast iron. If the weld was built up high, enough steel might surround such bubbles to more

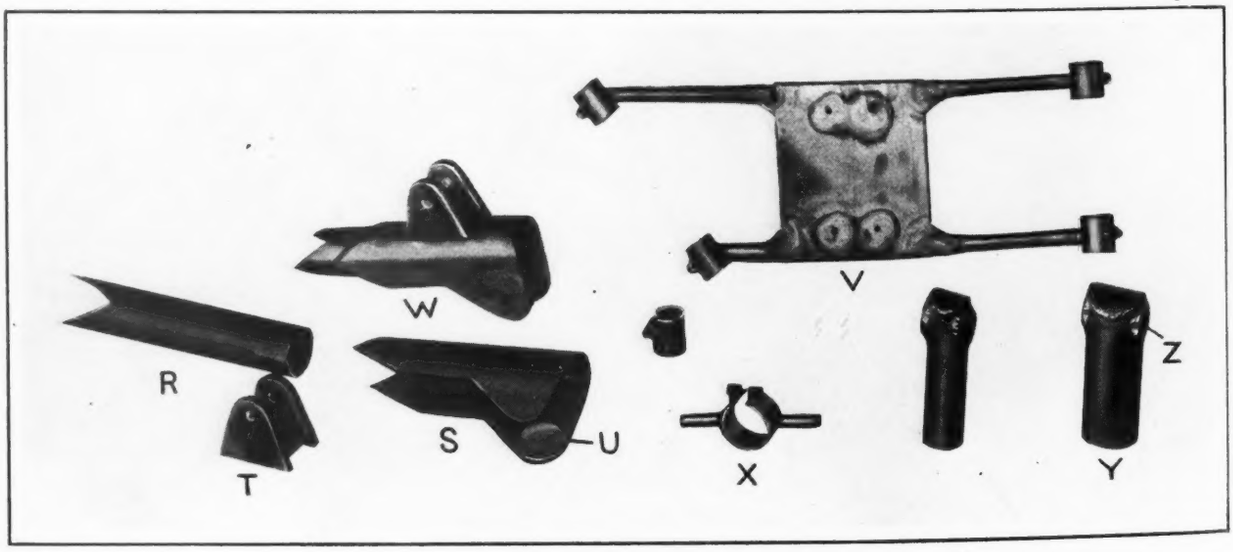


Fig. 3. Wing Fittings and Bracket for Engine Controls

than equal the area of the tubing and thus give enough strength; in that case, no great harm would be done.

It is poor policy, however, to trust to these "ifs" in building airplanes that might fall and end human lives. Such conditions necessitate the use of only the best of welders on this class of work. Even then a rigid inspection of welds is necessary, as welders are human enough to become careless and have bad days. When a welder adjusts his oxygen and carbon in the proportions that will give a neutral flame, each unit is so busy whirling around the other, in generating the flame, that they are used up and cast aside before they have a chance to enter the steel.

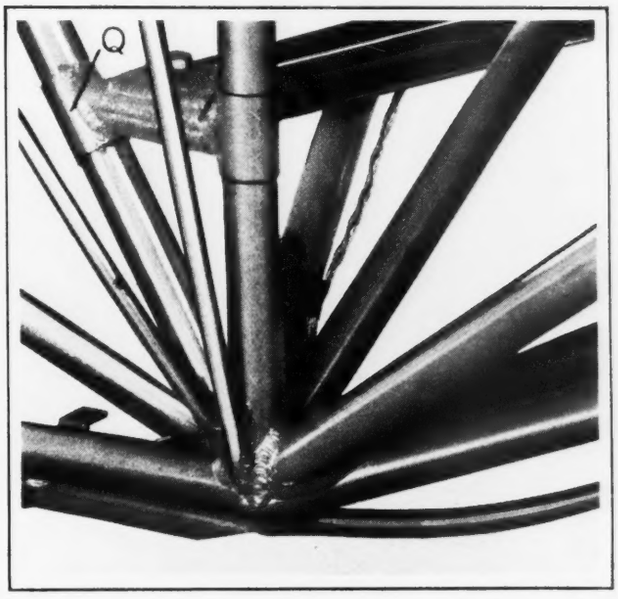


Fig. 4. Converging Tubes which are Welded in One Operation

Tubing Sizes Used in Fuselage Construction

In Fig. 2 is shown the large variety of tube sizes needed to build up this fuselage. The smallest of these is 3/8 inch, with a wall 0.035 inch thick, and the largest round tube is 2 1/4 inches in diameter, with a wall thickness of 0.058 inch. These tubes increase in size by 1/8 inch from 3/8 up to 1 7/8 inches, and each tube must be used in the proper place to give the fuselage the correct strength, lightness, and rigidity. To leave out any one of these would weaken the fuselage much more than its individual strength amounts to when standing alone. As in football, it is teamwork that really counts. The tube *P* with the extra thick wall is used in 8-inch lengths to reinforce the upper tubes at *C*, Fig. 1, for fittings to which the wings are bolted on each side of the fuselage.

The tube across the fuselage at *N* is 1 7/8 inches in diameter, with a wall thickness of 0.058 inch. It is the largest tube used in any part of the fuselage for a structural member, except the stream-line tubes at *D* and *E* (Figs. 1 and 2). Stream-line tube *D* is 3.748 by 1.562 inches, and 0.065 inch in thickness. A 2 3/4-inch round tube is used in making this stream-line shape. Stream-line tube *E* is 2.726 by 1.136 inches and 0.065 inch thick, and this is formed from a 2-inch round tube.

The 9-foot tubes at *F* and *G* are 1 1/2 inches in diameter and 0.049 inch thick. The landing apparatus is bolted beneath tube *F*, with braces running back to the tube *G* to take the lateral thrust or strains when hitting the ground. This takes the load of the entire ship, plus the force of the bump when the airplane is landed. This tube is well reinforced and backed up by braces at all six points where the landing gear is bolted. The other fuselage tubes and the bracing is so arranged that the load or shock of landing is spread throughout nearly three-fourths of the fuselage. The strains from taxiing the load over a rough landing field are also spread throughout the entire fuselage, and the rear wheel or tail-skid takes a part of this load.

Building up the Fuselage

In the heading illustration is shown a closer view of the mass of tubing required in the cabin section of the fuselage for various purposes. Here floor boards and seats must be supported; engine throttle and spark levers must be held in place; foot-pedals

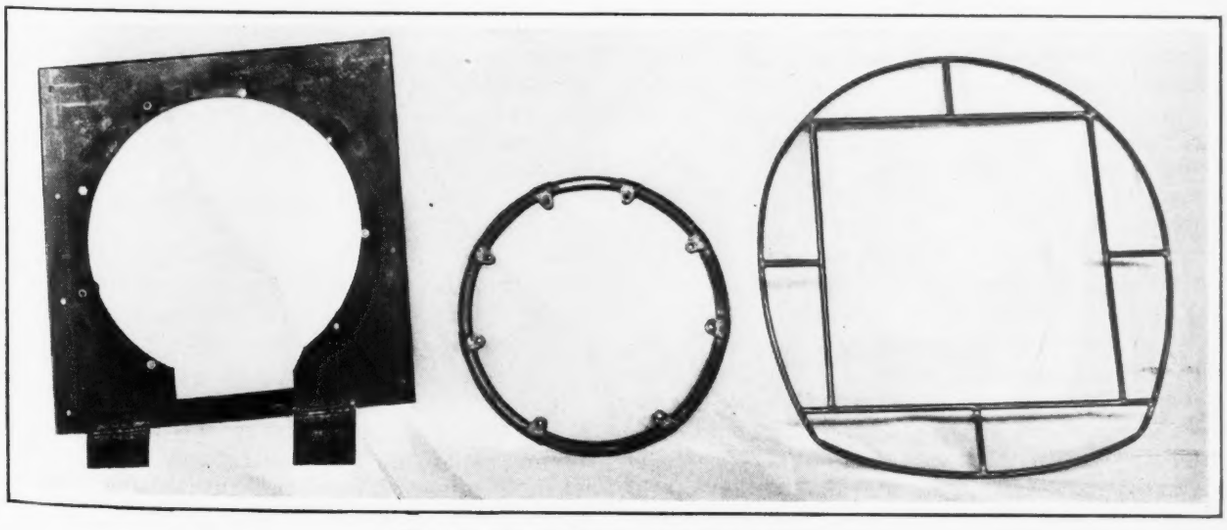


Fig. 5. Engine Mount and Cowling Rings

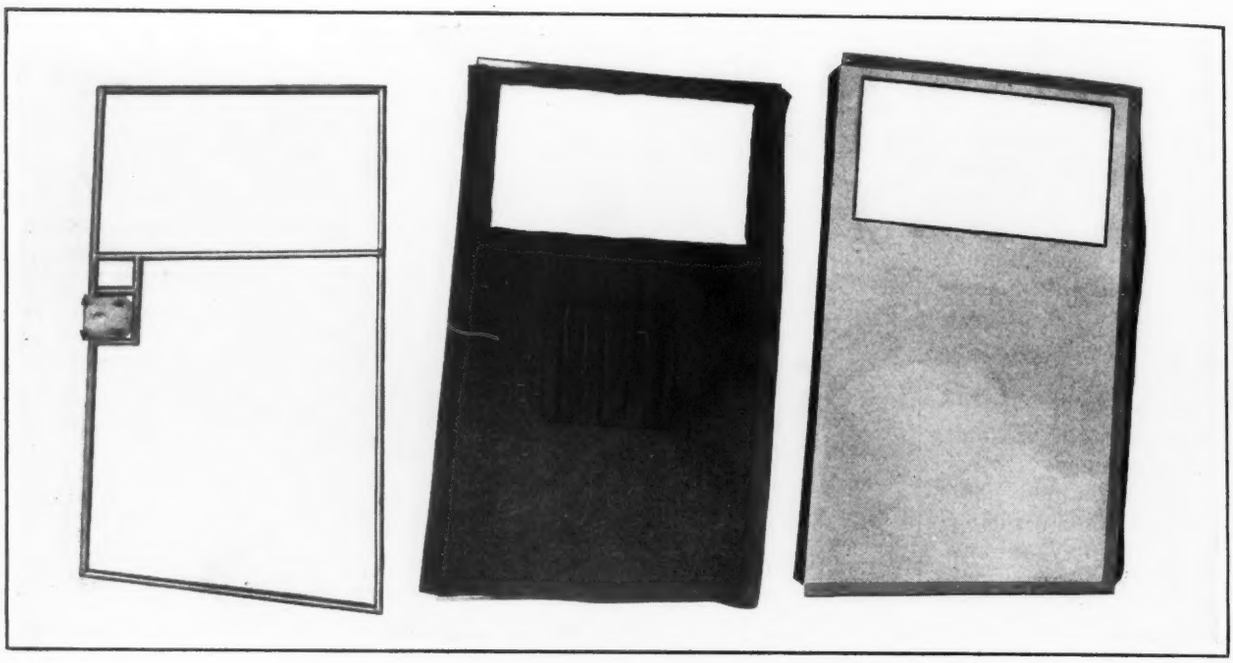


Fig. 6. Light Cabin Doors Made for Use on Airplanes

and sticks for guiding the ship must be located at both front seats for duo-control; instrument boards must be fastened; and various accessories must be held in place.

In building up this fuselage, the longeron tubes, shown at *H* and *I* in Fig. 1, are first laid down on a large flat table to which blocks have been screwed to locate them in the right position to give the fuselage the correct shape. These longerons start with a 1 1/8-inch tube at the front of the fuselage and gradually become smaller in size until they are 3/4 inch at the tail. The 1 1/8-inch tube is reduced by cutting its rear end to a fishtail shape like the end cut on the reinforcement tube at *R* in Fig. 3. Then a 1-inch tube is inserted and welded around this fishtail to the 1 1/8-inch tubes.

Welds are never made straight around any of the important tubes that are subjected to strains and stresses, owing to the fact that the inherent strength and toughness of the tubes can be preserved to a much greater degree if the welds are fishtail in shape. Another method of reinforcing a welded connection around a tube is shown at *Q* in Fig. 4. Here a larger tube is slipped over the main tube and tacked in place. Then the other tube is welded to this reinforcement.

After the longerons are properly located on the table, the upright tubes at each station, like the two marked *J*, Fig. 1, are fitted between the upper and lower longerons and spot- or tack-welded to hold them in place. Then all the side diagonal tubes, similar to those shown at *K*, are fitted into place and tack-welded. After that the tail-post is fastened to one of the sides, and the side frames thus assembled are taken from the table and stood up on the wooden rack in Fig. 1. Then the tubes that are square across the top and bottom of the fuselage, at each station, are fitted and spot-welded to hold the two sides together.

Next the diagonal tubes, between stations and across the top and bottom, are fitted and spotted into place. The fuselage is squared up by these tubes and then all other tubes and fittings are spot-welded in their proper places. No joint is welded until all the tubes entering that joint are in place. Then the complete joint is welded at one heating. To weld each tube after it was fitted in would mean heating the joint several times, and each heating would sap a little of the strength and toughness of the tube. That might multiply considerably in some of the complicated joints. Welds would also be placed where they would be covered up by other tubes, resulting in a waste of time and welding materials.

Many Tubes Centered at One Joint

Fig. 4 shows an enlarged view of the complicated joint shown at *A* in the heading illustration and in Fig. 1. Important stress member tubes come into this joint from ten different directions. Besides, there are three 3/8-inch tubes that act as facing for bolting on the sheet aluminum cowling that covers the fuselage back to the doors. Aft of the doors a special cloth covering is used. Much time and study was spent in trying to reduce the number of tubes in this joint, but the number shown is considered minimum.

This joint illustrates the benefits to be derived from only tack-welding the tubes in place and then, when they are all located, welding the complete joint around each tube at one heating. Elimination of warpage is another reason for this method of welding. When all the tubes are spot-welded in place, they hold the joint in the proper location during expansion and contraction from the heat when welding. This heat has sprung fuselages when some welding was done before all the tubes were located.

The outside tubes in the assembly shown in Fig. 4 are 1 1/8 inches in diameter; the diagonals extending upward are 1 inch, and the diagonal tubes across the bottom are 7/8 inch.

The last operation is that of welding numerous small steel angles in various places on the fuselage. Two of these angles are marked *B* in Fig. 1. They are made of 0.049 inch sheet steel, 3/4 inch wide, and each angle has a small bolt hole through it. To these angles are bolted floor boards of ply-wood; window and door frames; wood facing strips for the tacking of upholstery on the inside and the cloth covering on the outside; and other things required in the finishing and furnishing of the airplane.

The fuselage next goes to the paint shop to be painted in order to prevent rust. At this stage every piece must be welded in place, as no welding can be done on the fuselage after it is painted.

Duralumin Compared with Steel

When duralumin was brought out, it was thought that it would supplant steel in airplane construction, as its tensile strength and yield point are about equal to that of the carbon steel tubing sometimes used in the cheaper grades of fuselages; but duralumin cannot be welded. That makes a tubular structure similar to the fuselage described out of the question, owing to the difficulty of riveting thin tubing, and bolts would make the structure too heavy.

Where duralumin has been used, angles and channels take the place of tubing, as they can be riveted to a gusset plate or flange in a way that would make a tight joint. It would be extremely difficult to bring flanges out at the ten different angles of the tubes shown in Fig. 4 and leave room enough for riveting channels to them; moreover if this were done, the increase in weight would be greater than welded steel tubing even though the weight of duralumin is only one-third that of steel. Then, again, to obtain a strength equal to tubing a thicker sectional area would be required in either channels or tubes. For example, most of the tubing in this fuselage is either 0.035 or 0.049 inch in thickness. Angles or channels made from such thin metals would have very little strength or stiffness, as compared with the chrome-molybdenum tubing.

This tubing has nearly double the tensile strength and yield point of duralumin, and its resistance to vibrational or torsional strains is much more than double. Therefore, steel is still the best metal that can be used for this size and type of fuselage, and there is no worry about rivets working loose, as everything is welded.

Fittings for the Fuselage

The most important parts of the fuselage are the wing fittings and the engine mount. If either of these break, the wings come off or the engine tears loose. Then there is no possible way to control the ship and it crashes to the ground. Such accidents are caused either by poor workmanship or by the use of cheap materials and labor.

In Fig. 3 are shown the strong wing fittings that are welded to this fuselage. First reinforcing tubes *R*, with the fishtail end, are cut to the shape shown. They are then slipped on each end of the 9-foot spar tubes shown at *F* and *G* in Fig. 1, and spot-welded. Their inside diameter is such as will make a tight fit over these spar tubes. Next the piece marked *S*, Fig. 3, is blanked out of sheet steel and bent to the shape shown, so that it will fit tightly around tube *R*. Disks are welded to it at *U*, so as

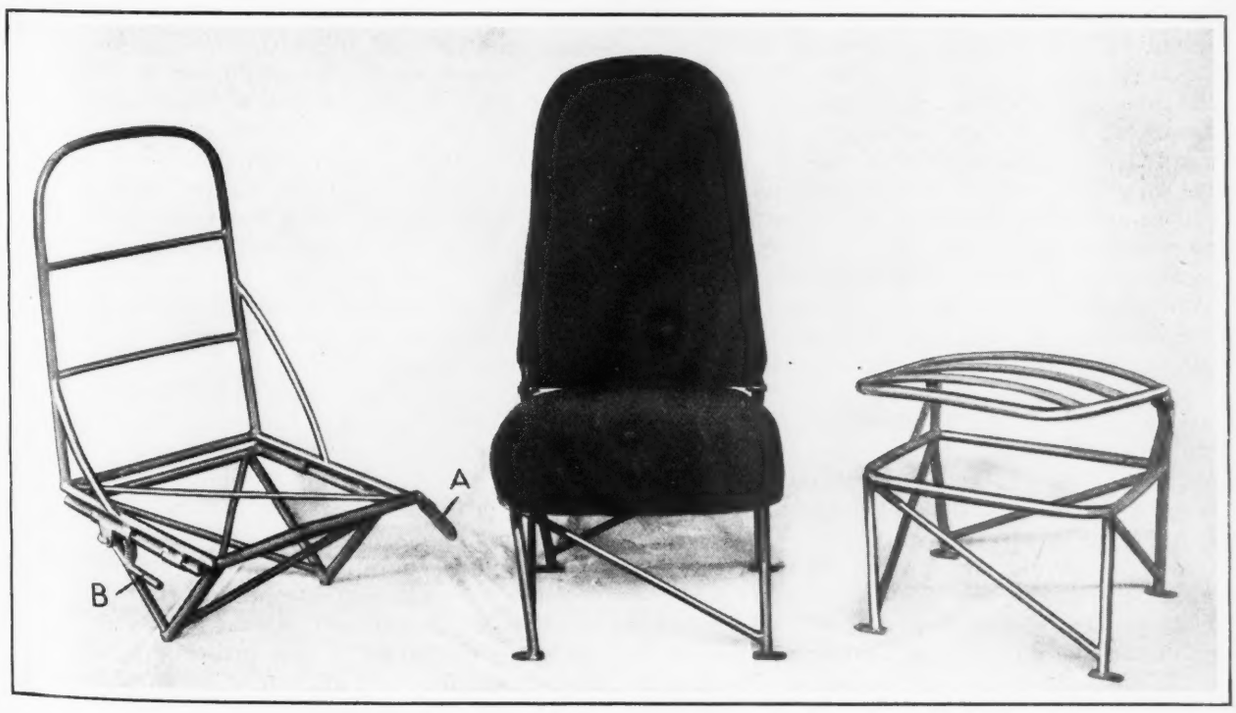


Fig. 7. Special Chairs for Pilot and Passengers

to give a greater bearing to the nickel steel bolts that are used to bolt on the wings.

Then lug *T* is blanked out and built up from three pieces of 1/4-inch steel, namely, the two ear lugs and a spreader that holds them the right distance apart. The correct assembly of these pieces is shown at *W*. These parts are welded to spar tubes *F* and *G*, Fig. 1, before they are laid down in the fuselage. Then bolts at *L* and *M* locate these spar tubes in the correct position on which to build up the rest of the fuselage.

The bracket *V* in Fig. 3 is located beside the pilot's seat and holds the engine control and spark levers. It illustrates the way such parts can be fastened securely to the fuselage without welding. To make these fastenings, a small tube with the correct bolt hole size is welded across a larger tube of the right size to do the clamping. Then it is split as shown at *X*. Such parts are never welded to any of the stress members of a fuselage, as that might reduce their strength and toughness from 20 to 40 per cent.

The part at *Y* is the upper wing fitting. It is made of the extra thick tube shown at *P* in Fig. 2, with a cap over its top end. A hole is drilled through its center at *Z*, and a tube is inserted and welded. This tube has a hole large enough to fit the wing bolt and a 5/32-inch wall.

Parts of smaller size (like the one next to *Y*) are built up in the same way. These parts must be a tight fit in the tubes *C*, Fig. 1, as they are forced into them and welded in place. As an extra precaution, two rivets must be put through tubes *C* and the shank at *Y*, Fig. 3, to satisfy the requirements of the Aeronautical Chamber of Commerce. This makes a wing connection that it is almost impossible to tear off or break.

Some might wonder why this piece is not made solid. There are two good reasons: If it were solid, it would be very difficult to weld it into tube *C* without burning away some of the thinner metal of the tube. Such welds are not a success commercially where the strength of metals must be preserved. The second reason is the weight. The extra weight of one piece might not mean much, but there are a hundred other places on an airship to be considered.

In Fig. 5 is shown the way the ring is built up that holds the engine on the fuselage; also the frame surrounding the engine ring, to which is bolted the sheet aluminum cowling that gives the airplane its shape. This cowling ring is built on a flat board to which are fastened blocks that hold the tubes in place while they are being welded. It is made of 3/8-inch tubing, 0.035 inch thick, and shows the outside shape of the ship before the engine is bolted in place.

The engine mount ring, in the center of the picture, is held on the steel plate to the left while it is being welded, so each bolt hole will line up with the holes in the engine. Attempts were made to spot the pieces in place and take it off the plate to do the final welding; but this proved to be an utter failure, as warpage under the welding heat would spring the tube out of shape enough to throw some of the holes as much as 1 inch out of alignment. This plate must also be left bolted to the ring until it has been welded in place on the fuselage and all parts have become really cold.

First a 1 1/8-inch tube, 0.058 inch thick, is bent to a circular shape, and the ends butted together over a reinforcement, to which they are welded. This joint is made to come under one of the lugs to strengthen the tube as much as though no weld were there. The lugs are blanked out of sheet steel and then bent U-shape so they will fit the 1 1/8-inch ring tube. That leaves two ears projecting on the inside of the ring, and a spacer of 5/8-inch tubing is located between these ears, with a hole that fits the engine bolts. This whole assembly is then bolted to the plate with the hollow center and welded up. The cowling ring is next welded on and the whole unit is welded to the fuselage.

That this engine mount and the entire fuselage is strong enough to carry the load of the whole ship is shown by the following incident. When flying over some wild country in Louisiana, the engine stopped and the pilot was forced to make a quick landing in the woods. The trunks of eight trees with diameters of from 7 to 9 inches were broken off; the wings of the plane were smashed beyond repair; the landing gear was broken; and the aluminum cowling was bent and dented. The fuselage, however, was not even bent, except where two tubes hit a stump.

Construction of Doors and Chairs

Fig. 6 shows how light it is possible to make cabin doors and still have them rigid enough to stay in place. The door frame is built up from 5/8-inch steel tubing, 0.035 inch thick. A welded plate holds the lock and door knob. All around the inside of this frame 1/2-inch by 1-inch wooden strips are fastened, to which the upholstery can be tacked, as shown by the middle door. As shown to the right, sheet aluminum is folded back on itself to stiffen the edges and form a molding; this is then bolted through the 5/8-inch tubes of the frame to form the outside of the door. These doors are 50 by 32 inches and weigh less than 4 pounds.

Fig. 7 shows the construction of chairs for cabin airplanes. These chairs must fit the fuselage, must be light in weight, and should be comfortable. For the legs, around the seat, and over the back, 5/8-inch steel tubing, 0.035 inch thick, is used, while 1/2-inch tubes of the same thickness are used for the diagonals and across the back. The passenger's chair is hinged so the back can be folded down (as shown at the right), and the pilot's chair (at the left) is adjustable fore and aft to accommodate short- or long-legged pilots.

The pilot's chair is fastened to the side of the fuselage by projection *A* to prevent it from rocking, and the fore and aft adjustment is effected through the three bolt holes in this projection. A greater adjustment fore and aft can be obtained by pulling up on lever *B* and then sliding the seat forward or back on the telescoping tubes.

THE ELECTRIC EYE IS NOW APPLIED TO INDUSTRY

How the photo-electric cell, the so-called "electric eye," may be applied in the steel industry was demonstrated by J. V. Breisky, research engineer of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., at a recent meeting of the Metropolitan Section of the American Electric Railway Association in New York City. The photo-electric cell can be used for determining temperatures of steel in various processes of manufacture. "No previous mechanical device," said Mr. Breisky, "has been quick enough to give the essential instantaneous record of the temperature of metal in the blast furnace, the tube mill, or the rolling mill."

To demonstrate this new use of the electric eye, the lecturer used a photo-electric cell, a glow heater, and a meter calibrated in degrees of temperature. A varying current was made to pass through the heater, the temperature of the heating element thus being made to rise and fall. The slightest change—hardly noticeable to the human eye—causes an instantaneous variation in the meter. In all the processes of steel manufacture, where accurate control of temperature is essential and where human sight finds it difficult to judge by brilliancy alone, the electric eye readily indicates temperatures from 1300 degrees F. up to the highest degree of heat encountered.

Another application of the electric eye is in the automatic control of the lighting of factories and offices. When the day is gloomy or a storm arises, or when for any reason the intensity of the daylight varies, artificial lights can be turned on and off automatically, as required. An unvarying degree of minimum light can thus be provided without human effort or judgment. This automatic control of light is now used in one of the large factory aisles in the plant of the Westinghouse Electric & Mfg. Co. at East Pittsburgh. It has proved so effective that several large industrial concerns throughout the country are now installing this equipment. Similarly, streets lights may be automatically controlled so that adequate illumination without waste is provided at all times, without human attention.

Demonstrations were also made of other devices made by the Westinghouse company in which the photo-electric cell is used. The people entering the meeting room were automatically counted as they crossed the beam of light thrown across the doorway. An automatic sorting machine was able to detect differences in the appearance of packages. Another device operated a fire extinguisher as soon as a whiff of smoke appeared within the range of the electric eye. It is interesting to note how many uses have already been found for the practical application of a machine that can "see."

* * *

MATERIALS-HANDLING EQUIPMENT SAVES MORE THAN LABOR COST

In a paper on materials-handling equipment read by N. H. Preble, vice-president and chief engineer of Mechanical Handling Systems, Inc., Detroit, Mich., before the national meeting of the Materials Handling Division of the American Society of Mechanical Engineers, which was held in Chicago in March, the author emphasized that there is some danger of looking at the question of materials-handling equipment purely from the standpoint of labor saving, perhaps because that is the easiest thing to determine in definite figures. Frequently, however, there are other considerations of equal and sometimes greater importance. It is conceivable that the total production of a plant can be materially increased; or that a very serious congestion in aisles, driveways, or elevators could be reduced sufficiently to warrant a considerable expenditure. In other instances, excessive breakage or damaging of goods might, without effecting a reduction in labor costs, be a sufficient factor to warrant an installation which in itself would not make any saving in labor costs. Conditions of this sort are not by any means unusual and a materials-handling problem should be analyzed from other angles than that of labor-cost alone. Frequently, labor-cost savings are overemphasized in considering equipment of any kind, when savings in materials, for example, may be more important.

Tubing with Walls 0.004 Inch Thick

A new development in the art of drawing tubes which has made it possible to produce tubes up to 9 inches in diameter in lengths of 20 feet with extremely thin walls—as thin as 0.004 inch—will be dealt with in a feature article in June MACHINERY. The tube-drawing machine in which these remarkable results are obtained will be illustrated and described. A remarkable feature of the new process is that the loss from scrap due to the parting or breaking of these thin-walled tubes is less than 1 per cent. For very thin tubing, the losses, with ordinary draw-bench methods, have been as high as 35 per cent. The wall thickness and diameters of the tubes drawn by the new method can be held to very close tolerances.

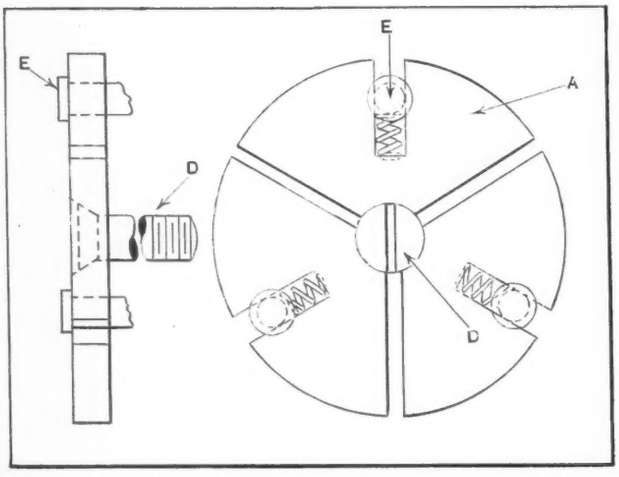
* * *

NATIONAL WESTERN METAL CONGRESS

The Second National Western Metal Congress and Exposition will be held next year on the Pacific Coast. The week of February 16, 1931, has been selected for this Congress, which will be held in the Civic Auditorium in San Francisco, Calif. The western sections of twelve national societies will cooperate with the American Society for Steel Treating in arranging the technical programs and organizing the exhibition. The First National Western Metal Congress was held in the Shrine Auditorium, Los Angeles, in January 1929, at which time there were 176 exhibitors. Further information may be obtained from W. H. Eisenman, secretary of the American Society for Steel Treating, 7016 Euclid Ave., Cleveland, Ohio.

Ideas for the Shop and Drafting-room

Time- and Labor-saving Devices and Methods that Have been Found Useful by Men Engaged in Machine Design and Shop Work



Expanding Device for Locating Work in Jigs and Fixtures

LOCATING DEVICE FOR JIGS AND FIXTURES

The expanding locating device shown in the illustration can be used to locate, and in some cases, hold the work in a jig or a fixture when the locating hole in the work is either cored or rough-machined. The device consists of three movable segments or jaws *A* which move in or out, depending on the direction of movement of the tapered-head screw *D*. This expanding movement forces the outer edges of the segments against the locating hole in the work. Thus not only does the device locate the work in the correct position for machining, but in many cases the gripping power of the segments is sufficient to hold the piece in the jig or fixture with no further clamping. Therefore, this device is especially advantageous in cases where the clamping of the work in the usual way is impractical.

The screw *D* may pass through the jig plate and be operated by a nut, or it may be operated in a tapped hole in the plate, depending on the particular job to be done. If operated by a nut, the screw should be keyed to prevent it from turning when drawn into the taper of the segments. The segments *A* are retained at the center by the taper of the screw *D* and at the outside by the headed pins *E*. These pins, sliding in their respective slots, also serve as guides for the sliding segments. Springs are inserted between the pins and the end of the slots to keep the segments in contact with the screw *D*. The writer has employed the principle of this device in various jigs and fixtures where the work was located from a hole or opening of irregular shape.

Cleveland, Ohio — C. H. HAYS

GALVANIZED FINISH ON BLANKS FACILITATES GEAR-CUTTING

In cutting the teeth in small thin spur gear blanks held in clusters on an arbor, it was observed that the cutter became heated when the galvanized finish ordinarily applied to the blanks was not used. This heating of the cutter became so excessive when cutting the ungalvanized blanks that it was necessary to reduce the machining speed in order to prevent burning the cutter. Apparently the lubricating effect of the tin, which is rather oily to the touch, gave the galvanized blanks a better machining quality.

Ontario, Cal. — JOHN HOMEWOOD

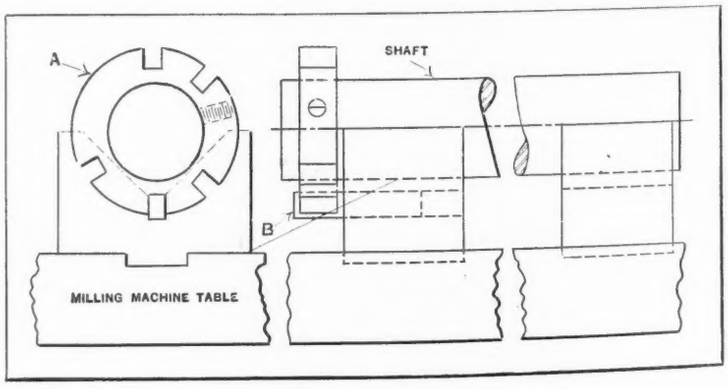
INDEXING RING FOR MULTIPLE SPLINING

Cutting keyways at various angles to each other on round shafts is usually a tedious job if each shaft is laid out separately. However, by the use of a special indexing ring all lay-out work is eliminated, a more accurate job is produced, and, in addition, the milling time is reduced.

Referring to the illustration, the shaft rests in two V-blocks which are aligned by tongues that fit in the table slot. The indexing ring *A* is slipped over the end of the shaft and prevented from rotating by a set-screw. Around the periphery of this ring there are four slots, located at the required angles and of the same width as the slot at the bottom of the vee. The key *B* is a slip fit in all five of these slots.

It is obvious that the operator has but to revolve the shaft in the V-blocks and insert the key *B* in the proper slot to locate the shaft accurately for milling the spline. The splines in the shaft will be at the same angle as those on the ring *A*. Accuracy of the angles is also assured, since all grooves in the indexing ring are milled on an indexing head.

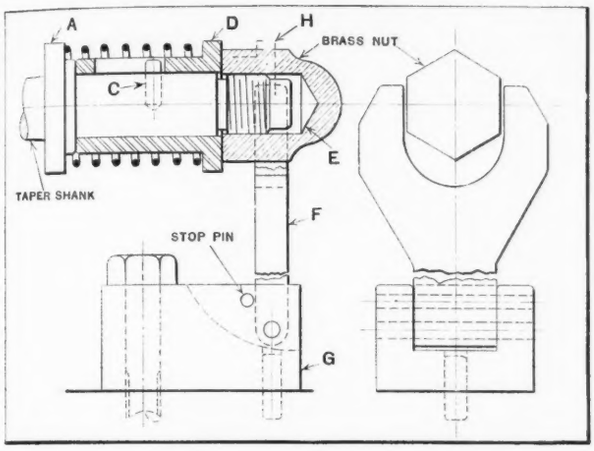
C. K.



Indexing Ring for Multiple Splining

RELOADING NUT ARBOR WITHOUT STOPPING LATHE

Much of the time consumed in finishing nuts on the regular type of nut arbors is due to the necessity of stopping the machine each time to remove and load a nut. With the arrangement illustrated,



Nut Arbor which Permits the Removal and Loading of the Nuts while the Spindle is Revolving

it is unnecessary to stop the machine during the entire job. The brass nut shown, which was previously machined in a turret lathe from bar stock, is filed and polished on one end.

The arbor *A* has a tapered shank at one end to fit the polishing lathe spindle, while at the other end a thread is cut on which the nut screws. The sliding sleeve *D*, actuated by a coil spring, is held in its normal position by the stop-pin *C*, as shown by the dotted lines at *H*. It is obvious that if an attempt were made to load the nut on the revolving arbor without some means of centering and squaring it before the mating threads became engaged, the nut would tend, in most cases, to cramp at the beginning of the thread. This condition is eliminated by the pilot *E*, which centers the nut, and the face of sleeve *D* which squares it up, thus insuring a true start for the nut as it is screwed on the revolving arbor.

The lever *F* is pivoted in the block *G*, which, in turn, is fastened by a cap-screw and dowels to the lathe bed. To remove the nut from the arbor, the direction of rotation of the spindle is reversed and the lever *F* is swung up to the position shown. The nut is thus prevented from turning and is unloaded through the action of the revolving spindle.

Glen Ridge, N. J. J. E. FENNO

TAPPING ALUMINUM

The main requirement in tapping aluminum is that the hole be of the correct diameter. The usual tap drill size will be found satisfactory, but an allowance must be made for the class of aluminum to be tapped when selecting the tap drill. Soft aluminum, such as aluminum plate, requires a slightly larger drill than the harder aluminum castings. In the first place, the drill does not cut so large a hole in the softer metal, because it is more compressible. The tap also has a compressing as well as a cutting action, and if the hole is too small, the tap has a tendency to bind. This tendency is more noticeable in the soft aluminum plates than in the harder castings.

Either beeswax or tallow will be found a very efficient lubricant for the taps. These lubricants can be melted and run into the holes to be tapped. The pressure and the heat developed during the tapping operations will keep the lubricants in a sufficiently liquid state. Beeswax and tallow have much more body than the lubricants commonly used, and for this reason give better results.

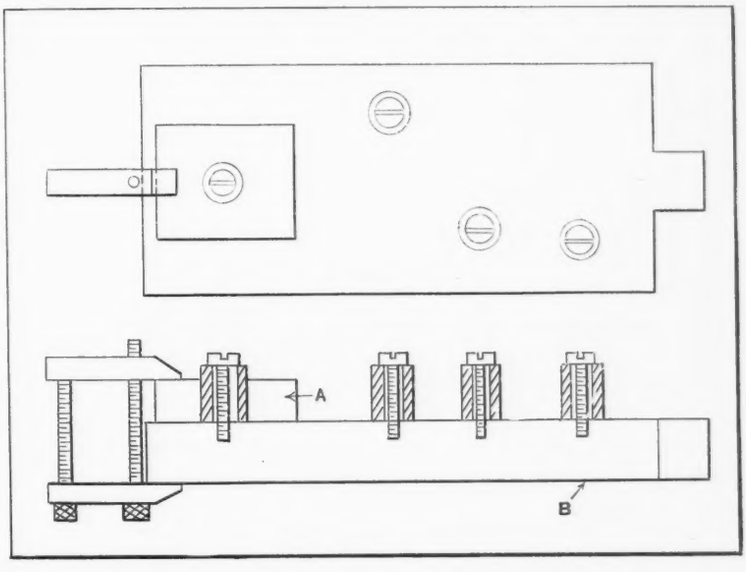
Brighton, England W. E. WARNER

SPACING HOLES RAPIDLY WITH TOOLMAKERS' BUTTONS

Spacing holes accurately and rapidly by means of toolmakers' buttons can be done in a drill press by the aid of a simple hardened and ground steel block in which there is an accurately ground hole that is a slip fit over the buttons. Referring to the illustration, the plate *B* is to have four reamed holes the same size as the buttons, which must be accurately spaced.

The buttons are first spaced and assembled on the plate in the usual way. Next, the block *A* is slipped over one of the buttons and clamped to the work, after which the button is removed. A drill the same size as the button is now used to start the hole in plate *B*. This is followed by a reamer drill. Finally the hole is reamed. Since the reamer is the same size as the button, it will be guided accurately by the hole in block *A*. In case the holes in plate *B* are to differ in size from the buttons, slip bushings can be used in block *A*.

Philadelphia, Pa. CHARLES KUGLER



Button Method of Spacing Holes, Employed on a Drill Press

Questions and Answers

ELECTRIC WIRING FOR PORTABLE MACHINES

A. M. W.—What is the law in regard to wiring portable machinery? Must cables be armored or rubber-covered?

Answered by Leo T. Parker, Attorney at Law, Cincinnati, Ohio

In the majority of states, the law requires wiring for portable machinery to pass the inspection of municipal or state inspectors. The reason for these laws is to prevent conflagration and injuries to employes. Some states have adopted laws specifying a particular insulation. In other states, the owner of portable machinery is not required to use any special insulation except that which will pass inspection from the standpoint of safety.

On the other hand, the law is well established that it is the duty of an employer to provide as reasonably safe a working place as the circumstances will permit. Furthermore, he is legally bound to exercise "ordinary care" in determining that the premises, machines, tools, and appliances are free from apparent defects which are likely to cause injury. Otherwise the employer will be liable for any injuries sustained by employes as a result of furnishing electrical appliances that might inflict injury.

The exact meaning of the term "ordinary care" has been the chief point of discussion in numerous legal controversies involving injuries to workmen. Just what it means depends upon the particular circumstances under which an accident happens. However, it has been held that the term "ordinary care" is that degree of care which would have been exercised by a reasonably prudent and careful employer under the same circumstances before the occurrence of the accident. (2 S. W. (2d) 760)

ELIMINATING SOUND AND VIBRATION

L.M.S.—I understand that certain machines are being mounted on cushioning pads of some material that effectively lessens the vibration and noise. Can you tell me what materials are being used for this purpose?

A.—Sound- and vibration-proofing is a problem of constantly increasing importance. The pad of vibration-deadening material placed between the machine and the floor may be solid cork plinths from 1 to 2 inches thick. These pads are metal-bound into sections several feet square, and can be easily handled. When used between the machine and the floor, they deaden the sound and often absorb vibration to such an extent that it is unnecessary to bolt the machine down.

The installations are generally made with a thin sheet of steel on the top surface of the pad. The sheet steel distributes the load, protects the cork from abrasion, and facilitates leveling the machine. Natural cork is not injured by oil as is the pulverized form. These pads are most commonly applied to motor-driven wood-working machines, pumps, and presses.

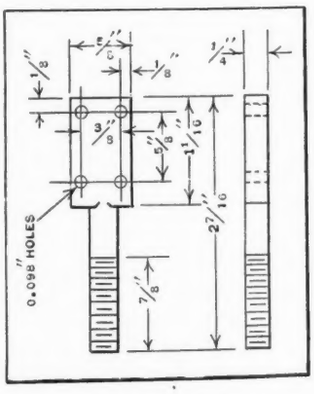
COARSE- AND FINE-THREAD MACHINE SCREWS

L. G. A.—What information can you give concerning the present standard for machine screws? Has the A.S.M.E. Standard been quite generally superseded by the American Standard, and if the latter has been adopted, is the bulk of production made to the coarse-thread series of pitches?

A.—According to information received recently from a number of the largest machine screw manufacturers in the United States, the proposed American Standard, prepared by a sectional committee on the standardization of bolt, nut, and rivet proportions, is now in very general use. This standard includes machine screws, cap screws, and wood screws. In each plant from which definite percentage figures were obtained, approximately 80 per cent of the production has the coarse-thread series of pitches, and 20 per cent the fine-thread series. These two series of pitches for different numbered and fractional screw sizes may be found in MACHINERY'S HANDBOOK, Eighth Edition, page 1169.

PIERCING HOLES IN BRASS PART

F. K. A.—We would like to know the best method of piercing or perforating the four 0.098-inch holes in the part shown in the accompanying illustration. The material to be used in making this part is half-hard brass strip stock. It is desirable to avoid, as far as possible, any appreciable bulging of the part at the sides near or adjacent to the holes. The pieces are to be made in large quantities. Can any of MACHINERY'S readers describe a satisfactory method of handling this job?



Brass Part with Four Pierced Holes

Answered by Joe Marshall, Philadelphia, Pa.

To punch the holes shown, the writer advocates doing the job in two operations. In the first operation, all the holes would be pierced with an 0.088-inch punch, and in the second operation, they would be finished with a 0.098-inch punch. With this

method, burring of the bottom edge of the holes would be almost entirely eliminated and there would be less bulging than if the holes were finished in one operation. To further prevent bulging, the pieces could be placed in a nest constructed so that their sides would be well supported against the spreading action. A clearance of 0.006 inch should be left in both dies. Two separate dies could be made to do this work, but the cost would be greatly reduced by making one die with interchangeable punches and die bushings.

Answered by Roy A. Dressler, Millersburg, Pa.

In endeavoring to solve the problem of piercing the four holes in the small brass part, the writer designed the die shown in Fig. 1. The part *A* is located on the die between the pins *B*, which form a nest for the work. The four punches *C* are guided and supported at their lower end by the shedder bushing *D*, which slides in member *E*. Member *E* is screwed and doweled to the punch-block *F*, and there is a center hole in it formed to the contour of the work.

Thus, as the punch descends, the upper part of the work will enter this hole and the walls will support the edges of the piece and prevent it from bulging while it is being pierced. A plan view of the punch-block members is shown in Fig. 2, the reference letters corresponding to those of Fig. 1. It is obvious that as the punch ascends, the work will be carried up; but near the top of the stroke, it will be ejected from the punches and member *E* by the shedder when the knock-out lever strikes pad *G*.

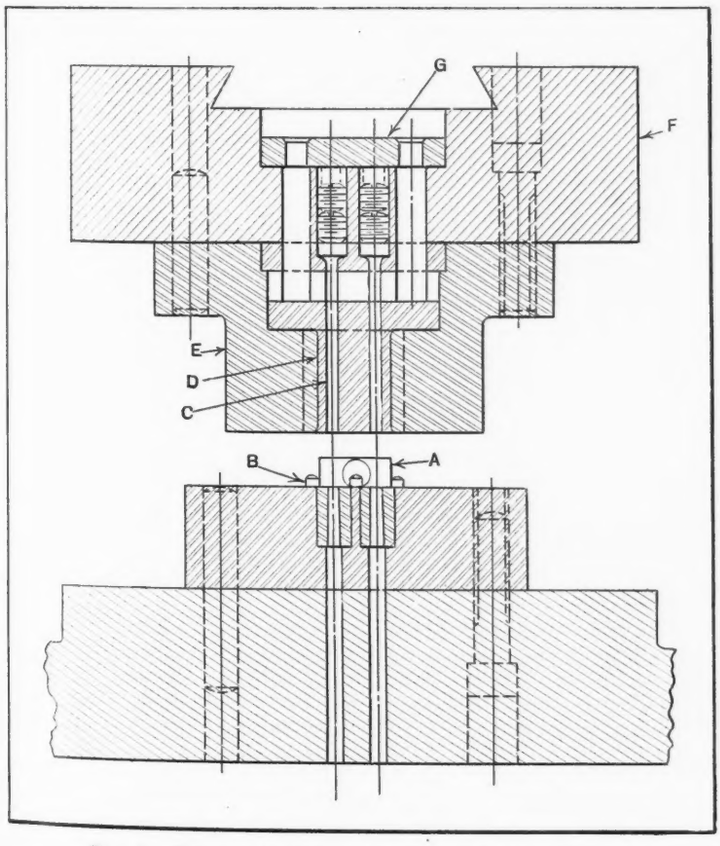


Fig. 1. Die in which Part is Supported Near Pierced Holes to Prevent Bulging

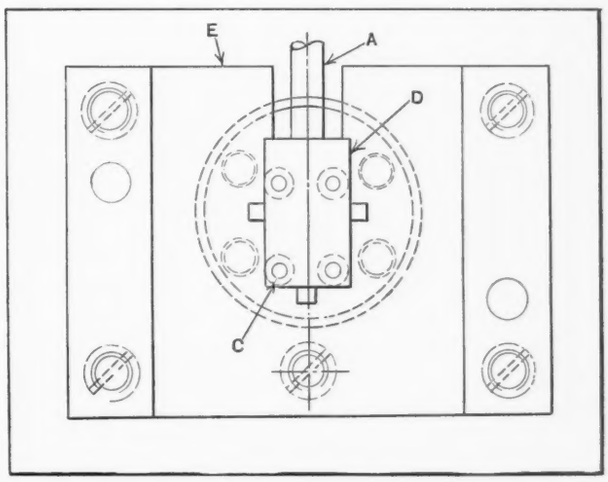


Fig. 2. Plan View of Punch-block Members

In case this design does not prove satisfactory, a double-acting tool might be tried in which a member similar to that shown at *E* would descend and completely surround the part before the piercing operation begins. It may be found, however, that tools of this type are prohibitive because of their higher cost.

TIME LIMIT FOR INSPECTION OF MATERIAL

E. B.—A factory signed an order for a quantity of material, which contained the following provision: "These goods shall not be returned, nor will allowance be made for any cause after thirty days from receipt." At the time the goods were received, they were placed in the factory's store-room without inspection. About ninety days thereafter, when the material was required for use by the factory, it was found to be defective in several respects. The factory demanded an adjustment, but the seller disclaimed liability on the grounds that he had not received notice of the alleged defects within thirty days, as required by the provision in the order. What are the rights of the parties in this situation?

Answered by Leslie Childs, Attorney at Law, Indianapolis, Ind.

A.—The time limit for inspection in the order is one frequently inserted in contracts of this kind to protect sellers against stale claims being made long after shipments have been delivered. The parties had the right to agree to this provision. There is nothing unreasonable about it, and the failure of the factory to make inspection and complaint within the time provided probably cut off its right to seek an adjustment thereafter for the alleged defects in the material, provided, of course, that the provision was fairly and openly entered into at the time the factory signed the order. (146 N.E. 214).

Mechanical Engineers' Fiftieth Anniversary

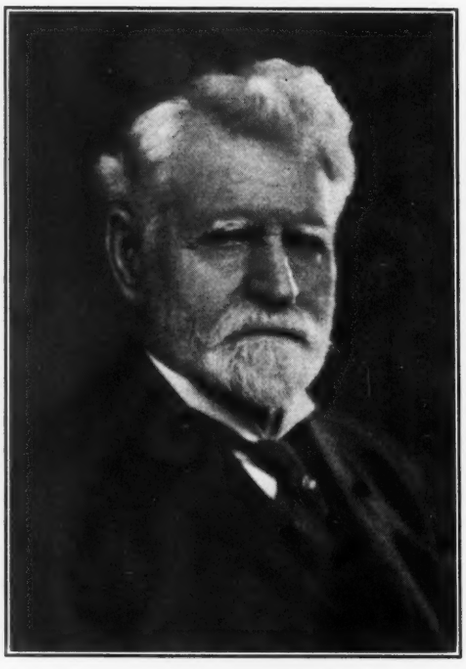
The American Society of Mechanical Engineers, Now Numbering 18,000 Members, Commemorates a Half Century of Activity

THE Fiftieth Anniversary celebration of the American Society of Mechanical Engineers, held in New York and Washington, April 5 to 9, marked a milestone in the history of engineering, not only in this country but throughout the world; for the event was one not merely of national, but of international, significance. Never before had such a large number of prominent engineers from all over the world been gathered together in this country. Delegates from twenty-one foreign countries participated with the engineers of the United States in this celebration, and the President of the United States, together with the ambassadors and ministers of fifteen foreign countries, gave the anniversary a truly international character. It was said that such an illustrious gathering of foreign diplomats had never before been known except at official state functions; and it is a most unusual thing for the President of the United States to honor, by his presence at dinner, a gathering that is not of an official character.

Unveiling Memorial Tablet in Engineering Societies Building

The Fiftieth Anniversary celebration, which was attended by representatives of seventy-five foreign engineering societies and institutions of engineering education, as well as representatives of over two hundred engineering societies and educational institutions in this country, began with the unveiling of a memorial tablet in the Engineering Societies Building in New York.

Later, an anniversary celebration of the preliminary meeting of the organizers of the Society was held in the offices of the *American Machinist* in New York, to commemorate the meeting held in the office of that publication, then located at 96 Fulton St., New York, on February 16, 1880. A fifteen-minute play, staging a reproduction of the 1880 office where the preliminary meeting was held, was the feature of this part of the celebration, which was continued by an Anniversary Pageant commemorating the organizing meeting of the Society, held in the auditorium of the Stevens Institute of Technology at Hoboken, N. J., where the first meeting of the Society was held fifty years ago.



Ambrose Swasey, One of the Six Living Founders of the A. S. M. E., and a Past President of the Society

The pageant was a combination of moving pictures and five brief one-act plays depicting the progress of engineering. The moving pictures, interspersed between these acts, contrasted the prehistoric past of dread and superstition with the future of confidence and knowledge, accentuating that in every age engineering in some form has been one of the fundamental means by which civilization has advanced.

A dinner of welcome to the foreign delegates, as well as to the delegates of societies and engineering institutions in the United States, concluded the celebrations in New York.

The International Character of the Event was Accentuated by the Washington Sessions

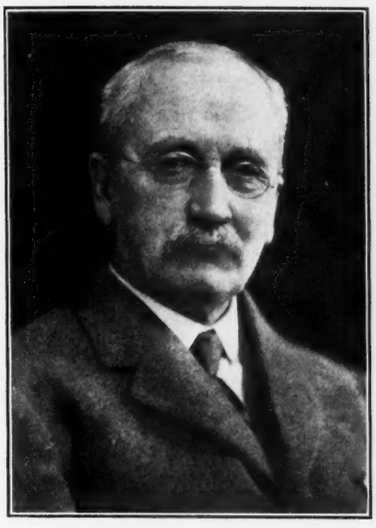
The more important functions of the celebration were held in the nation's capital, as befitted the international character of the occasion. At the welcoming assembly in the Council Chamber of the United States Chamber of Commerce Building, engineering organizations and educational institutions in more than twenty foreign countries presented greetings and felicitations. The countries that had sent delegates for this purpose were Australia, Austria, Belgium, Canada, Colombia, Cuba, Czecho-slovakia, Denmark, France, Germany, Great Britain, Italy, Japan, Mexico, Netherlands, Norway, Poland, Sweden, Switzerland, Turkey, and the Union of South Africa.

The presidents of each of the leading engineering societies in the United States—the American Society of Civil Engineers, the American Institute of Mining Engineers, and the American Institute of Electrical Engineers—presented greetings. During following sessions, ten-minute summaries of papers covering the aspects of engineering in all the leading countries of the world were presented by eminent representatives of the engineering profession from each country.

Eminent Engineers of Sixteen Nationalities Received the Anniversary Medal

One of the impressive events of the celebration was the conferring of the Fiftieth Anniversary

Medals upon sixteen engineers from as many countries, selected because of their prominence in the engineering profession. The ambassadors or chief diplomatic officials of each country presented to the Society, for the conferring of the medal, the distinguished engineer who had been selected to receive this honor by the engineering profession of his country.

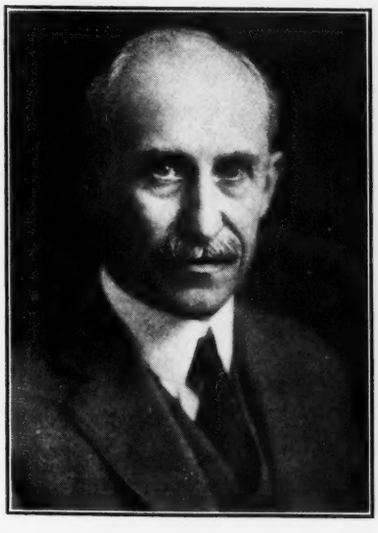


William LeRoy Emmet of the General Electric Co., Who Received the A. S. M. E. Medal

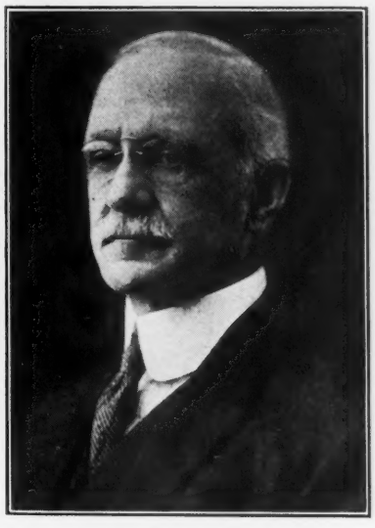
Joseph W. Roe, Professor, New York University, Who was Awarded the Melville Medal

At the same session, the Society's medals were conferred upon four outstanding engineers in the United States. Orville Wright was presented with the Daniel Guggenheim Medal for "notable achievement in the advancement of aeronautics." Fred J. Miller, a past president of the Society, was presented with the Gantt Gold Medal for "distinguished achievement in industrial management, as a service to the community." William LeRoy Emmet was presented with the Medal of the American Society of Mechanical Engineers, the highest honor conferred by the Society upon an engineer "for engineering or scientific achievement." Joseph W. Roe received the Melville Medal for "an original paper of exceptional merit presented to the Society for discussion and publication"—in this case, Professor Roe's paper "Principles of Jig and Fixture Practice" was presented at the annual meeting in December, 1928.

The crowning event of the celebration was the anniversary dinner at which President Hoover, accompanied by Mrs. Hoover, was present, in addition to many foreign diplomats and distinguished guests from foreign countries. At this occasion the first presentation of what will be known as the Hoover Gold Medal was made to Mr. Hoover. This gold medal, which was created through a gift of C. N. Lauer, a vice-president of the Society, is to be awarded from time to time to an engineer who has rendered distinguished public service, and it was considered most appropriate that the first award should be made to President Hoover in appreciation of the fifteen years of continuous public service that he has rendered since the time when he interrupted his engineering career in order to become the head of the Commission for Relief in Belgium.



Orville Wright, Pioneer in Aeronautics, Who Received the Daniel Guggenheim Medal



Fred J. Miller, Past President of the Society, Who was Awarded the Gantt Medal

President Hoover Emphasizes Need of Engineering Thought and Methods in Government

In accepting the medal awarded him, the President made an address in which he emphasized the need for the engineering method in the conduct of public and governmental affairs. He pointed out that, in solving the problems now confronting government, we have need for engineering knowledge and the engineering attitude of mind, as well as for the engineering method. "The problems of public relations are unsolvable," he said, "without the technical knowledge of the engineer. They are unsolvable without the engineer's fundamental approach to truth—that is, first to determine the facts and arrange these facts in proper perspective, and then to distill the truth from them in the retort of experience.

"Engineers do not undertake to build their gigantic tools, bridges, power plants, or railroads without knowing the service they are to perform, without infinite patience in the discovery of economic and scientific fact, without the adaptation of experience, without giving consideration to capacity in the human material available to conduct them, and without the final crystallization into positive, constructive action. No emotion enters into these deter-

minations. Emotion is permissible only in the contemplation of the service that can be rendered through them to humanity.

"But when the problems which these great tools create come to the door of government they are at once emotional problems, for the resolution of our people, for equality of opportunity, for freedom from domination, for maintenance of initiative and liberty of action, arise from the deepest of human emotions. Yet if we would find solution for these problems, if we would deal with them constructively, we must traverse the same hard road in determining the service we wish to perform as in engineering, dealing with them with infinite patience in discovering the economic and scientific facts, with careful adaptation of experience, with high regard for the human material available to conduct our administration, and with positive action in administration.

"Our greatest difficulty in dealing with these problems of government is when emotion comes first. Facts and the technical knowledge come but slowly or are often lost in a sea of embittered controversy. It is for all these reasons that the engineers with their training, their attitude of mind and their method, can contribute to the solution of the problems which arise from their own creations."

The problems of public relations are unsolvable without the technical knowledge of the engineer. They are unsolvable without the engineer's fundamental approach to truth—that is, first to determine the facts and arrange these facts in proper perspective, and then to distill the truth from them in the retort of experience. Our greatest difficulty in dealing with the problems of government is when emotion comes first. Facts and technical knowledge are often lost in a sea of embittered controversy. It is for these reasons that the engineers, with their training, their attitude of mind, and their method, can contribute to the solution of these problems.—President Hoover at the Fiftieth Anniversary Dinner of the Mechanical Engineers.

The Six Still Living Founders of the Society are Honored

Six of the 102 men who founded the American Society of Mechanical Engineers fifty years ago are still living. Of these, two were present at the anniversary celebration—Ambrose Swasey of the Warner & Swasey Co., Cleveland, Ohio, and Robert F. Grimshaw, consulting engineer, New York City. In honor of these men a Founders' Luncheon was given at which a special Founder's Medal was presented not only to the two members present, but also to those who, because of failing health, had been unable to attend the celebration. The enthusiasm of those present rose to great heights when Ambrose Swasey, who is also a past president of the Society, briefly reviewed the great advances in engineering and in civilization that had been made during the last fifty years.

What Is Not Yet, May Be

It was with great regret that those attending the celebration learned that the President of the Society, Charles Piez, was unable to be present because of the state of his health. Mr. Piez, however, sent a greeting based upon the words "What is Not Yet, May Be," with which the Fiftieth Anniversary Tablet and Medal of the Society is inscribed. In this greeting, Mr. Piez said: "At this point in our history when the entire world has turned its attention to us, let us not be satisfied to have it find us with our eyes cast backward to review the work of others. Let it rather find us looking beyond these achievements of which it is conscious, toward the obligations and opportunities of the future.

"Technologically, the future is secure. We have learned the art of applying science to useful ends. What we still lack is that greater wisdom to wipe out the plague spots, to bring about an orderliness in the control of the vast forces we unloose so that we may have progress without the waste in human and other material that has marred many of our past efforts. The problems involved are largely outside of engineering in its narrow sense—they are humanitarian, economic, and political problems. But before engineers can hope to realize the position that is rightfully theirs, they must arouse their consciousness and recognize that they are members of society and not merely technicians.

"Let this anniversary season, therefore, be one in which to restate ideals and strengthen purposes, and let us reconsecrate ourselves to the task that was set by the founders of this Society, so that the future may be as full of promise as the past has been of accomplishment. Before us lie opportunity and obligation. What is not yet, may be!"

* * *

WELDING SOCIETY MEETS

The annual meeting of the American Welding Society was held in the Engineering Societies Building, 29 W. 39th St., New York City, April 23 to 25. Among the papers read at the technical sessions were the following: "Distribution of Stresses in Fillet Welds," by L. C. Bibber, Bureau of Construction and Repair, Navy Department; "Investigation of Beams Welded to Columns," by Cyril D. Jensen, Lehigh University; "Battledeck Welded Floor Construction," by Lee H. Miller, American Institute of Steel Construction; "Stiffness of Welded Beam Connections," by C. H. Jennings, Westinghouse Electric & Mfg. Co.; "An All Welded Barge," by E. H. Ewertz, consulting engineer; "Welding of Tube Turns," by Nate Lord, Tube-Turns, Inc.

* * *

Exports of industrial machinery for the first two months of 1930 reached a total value of $43,000,000, a gain of nearly 9 per cent over the corresponding period of 1929. The exports of metal-working machinery in February totaled $3,512,000 as compared with $3,152,000 in February a year ago. The exports of metal-working machinery for the first two months of 1930 totaled $7,373,000 as compared with $6,270,000 for the corresponding period last year. The gains in exports were especially noticeable in drilling machines and forging equipment.

National Metal Trades Association Meets

The Stabilization of Employment, Industrial Education, and Relations of Management to Capital and Labor are Among the Subjects Discussed

THE thirty-second annual convention of the National Metal Trades Association, held at the Hotel Astor, New York City, April 16 and 17, can easily be recorded as one of the most successful meetings ever held by the Association. The papers presented were of an unusual character, bearing directly on many of the important problems now confronting management.

In his annual report, Harold C. Smith, president of the Association for the last two years, and president of the Illinois Tool Works, emphasized the work that has been done in connection with safety and accident prevention, industrial education, and industrial relations. He referred to the importance of the work now being done by the Committee on Industrial Education, of which Harold S. Falk, vice-president and works manager of the Falk Corporation, is chairman. This committee is preparing a comprehensive instruction course for machinist apprentices. The committee feels that such instruction can and should be standardized, and that the course now in preparation will prove of great value to the metal-working industry. Members of the Association at present are training 4720 apprentices. Attention has also been given to foreman training. On January 1, ninety-six plants reported that 2075 foremen were taking part in these training courses.

J. G. Benedict, General Manager, Landis Machine Co., Newly Elected President of the National Metal Trades Association

Mr. Smith also presented a summary of the replies received to a questionnaire on business conditions. A survey made in the middle of March, covering 600 plants, showed that 4 per cent reported business as excellent; 25 per cent, as good; 48 per cent, as fair; and 23 per cent, as poor.

In a brief address on industrial conditions in Europe, J. G. Benedict, general manager, Landis Machine Co., and newly elected president of the Association, outlined some of his observations made during a trip to Europe from which he returned a few weeks ago. Comparing wages in Europe and here on a dollars and cents basis, he found that the wages in the metal-working industries in England were only from 40 to 50 per cent of American wages; in France, 35 per cent; in Germany, 35 per cent; in Switzerland, 40 per cent; and in Italy and Belgium, about 20 per cent. He mentioned that almost everyone engaged in industrial pursuits in England, including many of the workers themselves, recognize that the unemployment dole is a mistake.

A very thoughtful and comprehensive address on the stabilization of employment was made by Sam A. Lewisohn, vice-president of the Miami Copper Co. Mr. Lewisohn made a plea for a careful study of the unemployment problem and painstaking efforts to formulate plans for stabilizing employment, both in individual plants and in entire industries. He feels that this can be done if those responsible for the management of industry will give the subject sufficient thought and work earnestly for the solution of the problem.

In his address on relations of management with capital and labor, L. F. Loree, president of the Delaware & Hudson Railroad, also brought out some extremely interesting points concerning the work done by this railroad to minimize the difficulties of their workers when laid off or discharged. He mentioned that his road pays $15 a week to every man laid off or discharged for any cause whatever, until he has found employment elsewhere, the maximum period for which such compensation is paid being six weeks.

Harold S. Falk, in his paper "Industrial Education," made a strong plea for proper training of men in the industries, pointing out the value of such training not only to the men and to the industry, but also to the community.

Alfred Reeves, general manager of the National Automobile Chamber of Commerce, spoke on the automobile industry; George E. Roberts, vice-president of the National City Bank, dealt with business conditions; E. K. Hall, vice-president of the American Telephone & Telegraph Co., spoke on essentials in personnel policies; Walter Gordon Merritt presented a paper on labor conditions in the electrical industry; and George Baerg, professor at Wesleyan University, told about conditions in Russia.

The following officers were elected: President, J. G. Benedict, general manager, Landis Machine Co.; first vice-president, Jacob D. Cox, president, Cleveland Twist Drill Co.; second vice-president, Harry C. Beaver, vice-president, Rolls-Royce of America, Inc.; and treasurer, John W. O'Leary, president, Arthur J. O'Leary & Son Co.

The Lapping of Tungsten-Carbide Tools

By H. J. WILLS, Engineer, The Carborundum Co., Niagara Falls, N. Y.

IT has been definitely established that a lapped cutting edge on a tungsten-carbide tool has from two to four times the life of an edge that has been ground only. Experience has also shown that when the edge is lapped, the quality of the finish-grinding is not so vital, and in some cases, it may not be necessary to use the finer grit wheels.

The principal objections to the lapping of tungsten-carbide tools have been the great cost of diamond dust—the material generally used—and the erroneous idea that the dull appearance of the edge when lapped with a less expensive abrasive, used loose on the lapping disk, indicates that the finish is not good. If the prejudice against a dull or mat appearance can be overcome, it will be evident that the use of the expensive diamond dust—costing from $9000 to $25,000 per pound—is not necessary.

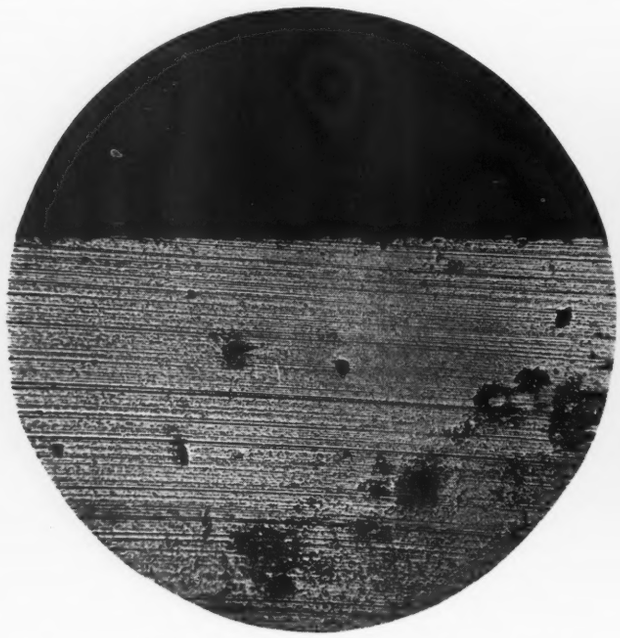


Fig. 1. A Tungsten-carbide Tool Lapped to a Bright Finish, Magnified Seventy-five Times

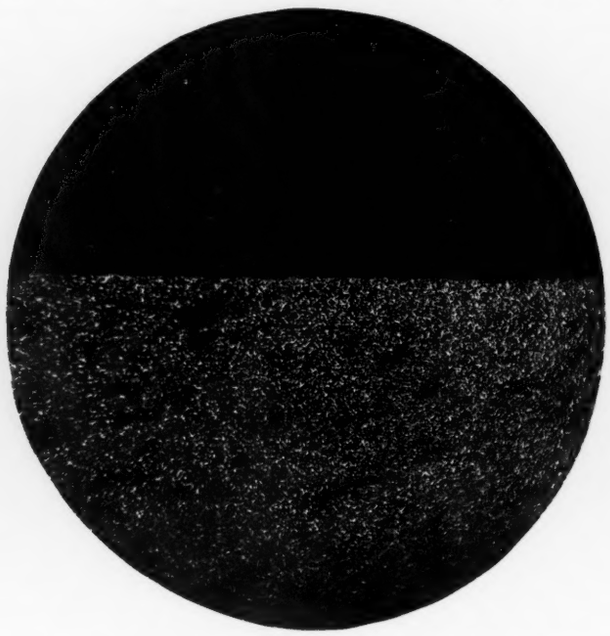


Fig. 2. A Tungsten-carbide Tool Lapped to a Mat Finish, Magnified Seventy-five Times

A comparison of the photomicrographs reproduced in Figs. 1 and 2 makes it clear that the difference between a bright and a mat surface is caused by the presence of scratches on the bright surface and a shallow pitting on the mat surface. The working edge of the tool shown in Fig. 2 has been found to be actually superior to that of the tool shown in Fig. 1, yet the abrasive for producing it cost only 70 cents a pound. A second lapping operation with a finer grit on a wooden disk, or lapping against a dry plate, will produce a polish, but the results will serve only to please the eye and will not influence the efficiency of the tool.

The following outline of the procedure in lapping tungsten-carbide tools with an abrasive compound developed by the Carborundum Co., Niagara Falls, N. Y., for fast and inexpensive lapping, will prove of interest. On the usual type of cast-iron lapping disk is mounted a whitewood or mahogany disk of approximately one-half the diameter of the cast-iron disk. The object of the wooden disk is to provide a softer lap for finishing, and by the use of this combination disk, a faster cutting compound can be used in the first operation.

In general, the lapping on the cast-iron disk with Carborundum Brand finishing compound—grading R40 Fine—is sufficient to produce a sharp edge and eliminate all chips and grinding marks. If a finer finish is desired, the same compound may be used on the wooden disk. This grade of compound leaves a dull mat finish from the cast-iron lap and a semi-polish finish from the wooden lap.

The best practice is to apply a small amount of R40 Fine compound on the cast-iron disk and hold the tool firmly to its face in such a position that the direction of rotation is against, and at right angles to, the cutting edge. When a satisfactory edge is obtained on all sides of the tool, the lapping operation may be repeated on the wooden disk, if a semi-polish surface is desired. In the second lapping, however, the tool should be held in a position that will lap at 5 degrees to the cutting edge, from back to front. If the tool is of such a shape that it can be held without tilting, this finishing operation should be done with a swinging motion across the direction of rotation, from 90 to 0 degrees to the edge, and from the back to the front. If a higher finish is desired, the use of grading R40 Ex. Fine is suggested on the wooden disk.

It should be noted that when using Carborundum finishing compound, the charging of the lapping disk is not necessary, nor are special grades of cast iron required.

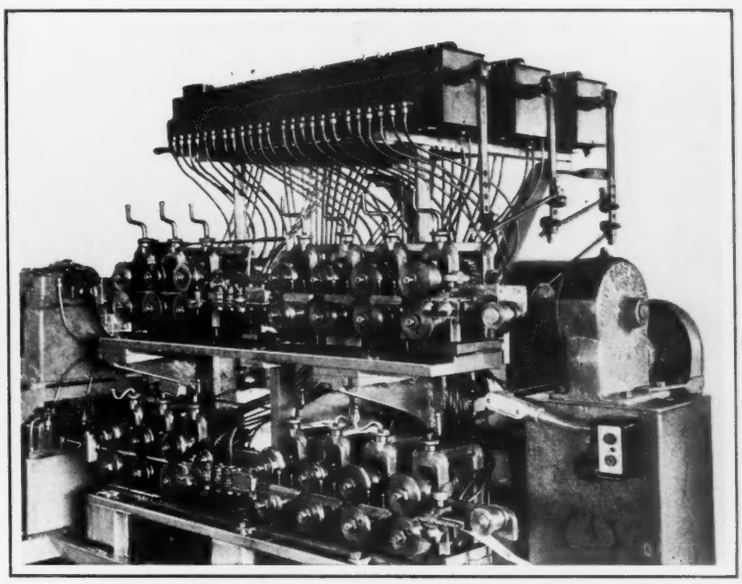
The speed of the lap is of decided importance, within certain limits. In general, a speed of from 900 to 1200 surface feet per minute gives satisfactory results. At higher speeds, the finish is noticeably affected and at 4000 surface feet per minute, there is practically no lapping action.

Small tungsten-carbide drawing dies can be lapped economically and satisfactorily with R40 Fine Carborundum Brand finishing compound in conjunction with the ordinary lapping tools employed for this class of work. Frequently, it is necessary to cut a groove in tungsten-carbide tools. This can be done by substituting an aluminum or brass wheel for an abrasive wheel in a grinder. Apply R40 Fine compound to the tool and bring the metal wheel to the work in the same manner as when using an abrasive wheel.

* * *

SEVENTY-TWO MACHINE BEARINGS LUBRICATED AUTOMATICALLY

A battery of three twenty-four-feed mechanical lubricators made by the McCord Radiator & Mfg. Co., Detroit, Mich., are shown in the illustration installed on a machine that forms tubes for tubular-type automotive radiators. By means of these lubricators, the seventy-two bearings on this machine are kept covered with a thin film of oil all the time that the shafts are in motion. When the machine stops, the supply of lubricant to the bearings also ceases automatically. Positive delivery of the oil in this manner protects the bearings against corrosion, acid, and acid fumes, besides offsetting friction. Approximately 250 feet of copper tubing is used in connecting the feeds to the lubrication points. To prevent any waste of oil, reduction gearing is used.



Three Mechanical Lubricators Supplying Oil to Seventy-two Bearings of a Tube Forming Machine

* * *

CONVENTION OF MACHINERY DISTRIBUTORS

The National Supply and Machinery Distributors' Association held its twenty-fifth annual convention, in conjunction with the Southern Supply and Machinery Dealers' Association and the American Supply and Machinery Manufacturers' Association, at the Peabody Hotel, Memphis, Tenn., April 3 to 5. Among the subjects discussed were the economic distribution of mill supplies and the value of composite reports of past selling prices. The distribution of a number of tools and supplies was also discussed, including wrenches and drop-forged tools, small mechanics' tools, hacksaw blades, electrical tools, files, drills, chucks, taps and dies, abrasives, chains and chain hoists, pulleys, shafting, belting, bearing metals, pipe valves, fittings, and saws.

INSTRUCTIONS AND GAGE FOR GRINDING WIDIA TOOLS

A great many—perhaps most—of the difficulties met with in the use of tungsten-carbide tools are due to faulty grinding, such as the grinding of too much clearance beneath the cutting edge, undercutting of the clearance by finish-grinding on the periphery of the wheel, grinding to incorrect angles, poor finish on the cutting edge, and other defects due to improper grinding. Careful and accurate grinding may be said to be one of the first essentials to the successful operation of tungsten-carbide tools.

With the intention of assisting manufacturers in obtaining better results from Widia tungsten-carbide tools, through improved grinding practice, Thomas Prosser & Son, 15 Gold St., New York City, American representatives of Fried. Krupp A. G. Steel Works of Essen, Germany, and distributors of Widia cutting tools in the United States and Canada, have prepared a sheet of grinding instructions, and have also devised a gage or templet of stainless steel for assisting in grinding Widia tools to the proper angles. The gage, together with the instructions, will be sent free to anyone engaged in machine shop work who asks for it.

The gage is intended for tools used for machining cast iron, as this is the material most commonly machined at this time with Widia tungsten-carbide tools. The instruction sheet, however, gives the angles for other materials as well. In grinding tools used for such materials, a protractor should be used; or the user can easily make his own gage along the same lines as the gage furnished for tools for cutting cast iron. It will be of interest to note in this connection that while the Widia tips for tools are imported, the tools themselves are manufactured in the United States by Thomas Prosser & Son.

Adjusting Ourselves to the Machine Age

A Study of the Facts Governing Production and Consumption Would Solve the Problems Introduced by the Labor-saving Machine

"One of the things that needs adjustment to the machine age is the mental state of many prominent people," said Ernest F. DuBrul, general manager of the National Machine Tool Builders' Association, in an address before the National Management Congress in Chicago, Ill., March 5. In this address, Mr. DuBrul pointed to many of the misconceptions held by men prominent in political and literary thought. He pointed out that the minds of many of the leaders in these fields are so out of touch with reality that they live in a dream of a past that has never existed. They want us to go back to the good old days of handicraft, not realizing that without machinery man can, at best, dig but a poor living out of even a rich soil. With machinery, men with comparatively modest incomes today have many things that it was impossible to obtain in the handicraft era.

Improved Machinery Has Made our Present-day Civilization Possible

Machinery has raised the standards of life of working people throughout the civilized world to levels of comfort undreamed of even by the wealthiest in the handicraft age. The American workman's bathtub and sanitary plumbing, his electric light, furnace, refrigerator, gas stove, washing machine, and vacuum cleaner make his house more comfortable than the palaces of kings were at the time of the American Revolution—only 150 years ago. His radio and phonograph bring him music that even kings could not command in those days, and his automobile takes him and his family to scenes of natural wonder and beauty that were inaccessible in former days.

Besides furnishing these things, machinery has made it possible for men and women in all walks of life to find time to enjoy the things they can procure. It has reduced the hours of labor and has given us the five and one-half-day week. "It seems probable," said Mr. DuBrul, "that if business were better organized for permanent prosperity, we could easily have the five-day week steadily right now. In oscillating between booms and slumps as we have been doing for so many cycles, many industries do not average five days per week operation over the entire cycle."

Business Fluctuations Could be Largely Avoided by a Study of Facts

Colonel Ayres of Cleveland has shown that, over a period of years, the production of the blast furnaces of the country averaged only 60 per cent of their capacity. If industry in general were better organized for permanent employment, there would not be such wide fluctuation in pig iron demand. The total capacity could be smaller than it is now, and yet the same amount of iron could be made by steadier operation.

The same conditions prevail in many industries. The present fluctuations in operation are due to defective knowledge of actual facts and defective application of the knowledge we have. These conditions, being man-made, can also be changed by man, by the introduction of better organization, more accurate knowledge of facts, and more thorough application of the knowledge at hand.

Steadier operation would be better for all concerned—for the business and for the workmen, who now work over-time at the peak of a boom and are thrown out of employment when the slump comes. "In my opinion," said Mr. DuBrul, "it is the duty of management to work very hard on the job of providing steadier operation. It is a social duty imposed on management, which is entrusted with a triple responsibility—to the workers employed by the industry, to the stockholders who own their industry, and to the social system that makes their industry possible."

The True Object of Industrial Effort

As we develop this machine age, we are able to produce more and more of the things we want with less and less human effort; therefore, our efforts are not confined only to securing steadier operation of the industries, but also to producing the needed amount of product with less human effort, or more product with the same effort. Further, production must be carefully adjusted to consumption.

In this connection, we must recognize, also, that we do not work mainly to produce goods as such; we work to produce satisfactions of human wants, some of which are met by the use of physical goods, others by human services. And to consume and enjoy the goods produced by machines, we must have time. The more time that some of us have to consume things, the greater demand will we create for many of the products of the machine age.

Now, since all industries are interdependent, it works to the benefit of all if the men engaged in production in all industries have more time to enjoy the total product that we all make; therefore, we should organize our forces to produce this product in the shortest possible time per man.

* * *

According to an estimate made by the National Automobile Chamber of Commerce, based on preliminary figures, the automobile production for March amounted to 400,000 cars and trucks. This total is approximately 18 per cent higher than the production in February, but 36 per cent lower than the production in March last year.

DIAMETERS AND TOLERANCES FOR GROUND THREAD TAPS

Commercial Tolerances for Machine Screw Taps Adopted by Tap and Die Manufacturers

Machine Screw Threads			Tap Measurements—Ground Threads					
Size and No. of Threads	Basic Screw Thread Diameters		Major (Outside) Diameter			Pitch Diameter		
	Major (Outside) Diam.	Pitch Diam.	Minimum	Maximum	Tolerance	Minimum	Maximum	Tolerance
6–32	0.138	0.1177	0.1395	0.1410	0.0015	0.1182	0.1187	0.0005
8–32	0.164	0.1437	0.1655	0.1670	0.0015	0.1442	0.1447	0.0005
10–24	0.190	0.1629	0.1925	0.1940	0.0015	0.1634	0.1639	0.0005
10–32	0.190	0.1697	0.1915	0.1930	0.0015	0.1702	0.1707	0.0005
12–24	0.216	0.1889	0.2185	0.2200	0.0015	0.1894	0.1899	0.0005
12–28	0.216	0.1928	0.2180	0.2195	0.0015	0.1933	0.1938	0.0005
14–20	0.242	0.2095	0.2455	0.2470	0.0015	0.2100	0.2105	0.0005
14–24	0.242	0.2149	0.2445	0.2460	0.0015	0.2154	0.2159	0.0005

Lead Tolerance

A maximum lead error of plus or minus 0.0005 inch in one inch of thread is permitted.

Thread Angle Tolerances

The permissible error in one half of the thread angle is plus or minus 30 minutes.

It is not commercial practice to grind taps smaller than No. 6 nor with more than 32 threads per inch.

The dimensions in this table apply to taps and not to tapped holes.

POWER REQUIRED FOR DRILLING—3*

Data Based Upon the Use of Sharp Twist Drills and a Coolant Consisting of One Part of Soluble Oil and Sixteen Parts of Water

Material and Heat-treatment	Hardness of Material			Drill Diam., Inches	Drill Feed, Inch per Rev.	Drill Speed, R.P.M.	Torque, Ft.-Lbs.	Thrust in Pounds	Horsepower at Drill Point
	Brinell No.	Rockwell B Scale	Scleroscope						
Steel S.A.E. 6120 Annealed at 1500 Deg. F. Reannealed at 1400 Deg. F.	137	76.5	25	1/2	0.009	445	14.6	712	1.25
				5/8	0.011	370	23.2	844	1.64
				3/4	0.012	298	36.0	1259	2.06
				1	0.013	224	72.0	1900	3.09
				1 1/4	0.015	175	118.4	2625	3.97
				1 1/2	0.015	150	163.0	3075	4.66
Steel S.A.E. 6130 Annealed at 1500 Deg. F. Reannealed at 1400 Deg. F.	156	81.5	28	1/2	0.009	445	14.1	760	1.20
				5/8	0.011	363	23.1	875	1.60
				3/4	0.012	298	36.0	1315	2.06
				1	0.013	227	68.5	1994	2.98
				1 1/4	0.015	176	112.0	2600	3.77
				1 1/2	0.015	148	157.2	3243	4.44
Steel S.A.E. 6140 Annealed at 1500 Deg. F. Reannealed at 1400 Deg. F.	163	85.5	28	1/2	0.009	445	15.5	712	1.32
				5/8	0.011	362	23.4	856	1.62
				3/4	0.012	298	36.6	1317	2.09
				1	0.013	226	67.8	2048	2.94
				1 1/4	0.015	179	114.0	2627	3.92
				1 1/2	0.015	148	155.0	2934	4.38
Steel S.A.E. 9250 Annealed at 1500 Deg. F. Reannealed at 1400 Deg. F.	202	93	32	1/2	0.009	445	13.7	837	1.17
				5/8	0.011	362	21.6	960	1.50
				3/4	0.012	298	32.9	1400	1.88
				1	0.013	226	61.2	2433	2.66
				1 1/4	0.015	176	102.6	2900	3.46
				1 1/2	0.015	150	144.4	3500	4.14
Steel Chromium-Molybdenum Annealed at 1500 Deg. F. Reannealed at 1400 Deg. F.	156	77.5	27	1/2	0.009	445	11.3	646	0.96
				5/8	0.011	363	19.6	787	1.37
				3/4	0.012	300	28.9	1153	1.66
				1	0.013	227	53.1	1575	2.31
				1 1/4	0.015	176	89.0	1987	2.99
				1 1/2	0.015	150	132.0	2433	3.78
Steel S.A.E. 1095 (Tool Steel) Annealed	154	85	25	1/2	0.009	445	15.4	852	1.31
				5/8	0.011	363	24.8	1067	1.72
				3/4	0.012	298	37.4	1566	2.14
				1	0.013	225	74.0	2575	3.19
				1 1/4	0.015	176	114.8	3327	3.86
				1 1/2	0.015	150	167.2	3983	4.78

*Data from paper on "Power Required to Drill Cast Iron and Steel," by O. W. Boston and C. J. Oxford, presented at the annual meeting of the American Society of Mechanical Engineers, December, 1929.

MACHINERY'S Data Sheet No. 178, New Series, May, 1930

MACHINERY'S Data Sheet No. 177, New Series, May, 1930

Sawing Armor Plate With a Carboloy Saw

A Record of Experiments Undertaken to Ascertain the Value of Carboloy-tipped Saw Teeth for Cutting Armor Plate

REMARKABLE results have been obtained in using saws equipped with Carboloy tooth points. In a recent test conducted for the Navy Department, as recorded in the April number of *Carboloy*, a saw of this type was used for cutting a strip of treated armor plate 16 inches thick, 9 feet across, and 17 feet long. This material is one of the hardest and toughest of alloy steels. Another test was also conducted under similar conditions, using a high-speed saw of approximately the same size and cutting the same plate. These tests, as described by Henry B. Allen and Lloyd P. Carpenter of Henry Disston & Sons, Inc., the firm that made both saws, permit a direct comparison to be made of the cutting action of each saw.

The sawing was done on a floor borer that was about ten years old and had been in constant use both day and night for two years. Much chatter, due to backlash, was present in this machine because the gears were considerably worn.

The Carboloy saw, shown in Fig. 2, was 48 inches in diameter, with forty-eight teeth. The Carboloy inserts were 5/16 inch deep and 1/4 inch thick. One-half of these teeth were set 3/64 inch higher than the others and cut a 3/16-inch kerf. The other teeth were square and finished the kerf to a width of 11/16 inch. The narrow and the wide teeth were located alternately in the saw. The high-speed saw was 48 1/8 inches in diameter, contained seventy-two teeth, and cut a kerf 3/4 inch wide, every other tooth being offset.

Carboloy Saw in Operation Twelve Hours without Resharpening and without a Coolant

Mounted on the spindle of the machine, as shown in Fig. 1, the Carboloy saw was started some distance from the end of the plate and fed in vertically. After 1 hour and 55 minutes of cutting, during which time the feed had been increased to 0.039 inch, backlash and chatter became so severe, due to the increasing load, that eight of the teeth showed slight chipping. Moreover, the indicator used to register the power consumed was rendered inoperative because of the violent vibration.

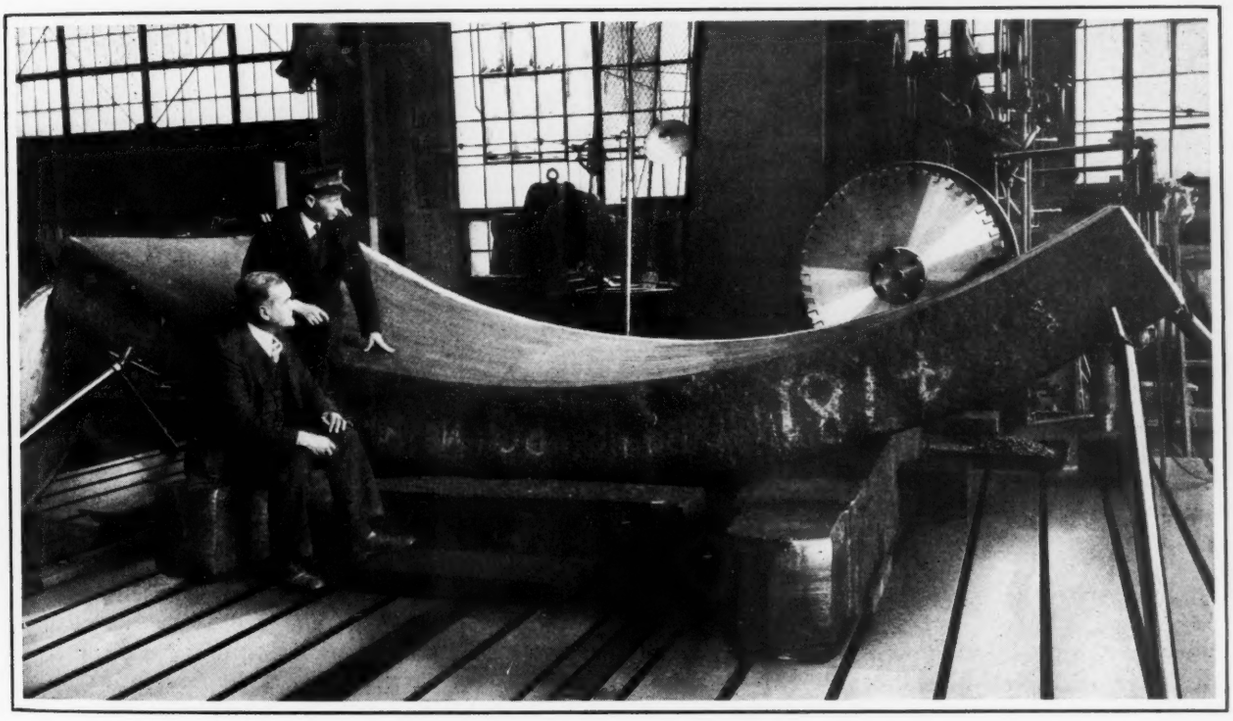


Fig. 1. Sawing Armor Plate 16 Inches Thick with a Carboloy-tipped Saw

To relieve this condition, the speed was reduced to one revolution for every 45 seconds. The vibration, however, still continued, so it was decided to feed the saw 1 inch forward and then 2 inches downward. Hence, the number of teeth engaged in cutting was decreased, and much of the chatter and backlash was eliminated, as a smaller part of the saw periphery—63 1/2 inches—was in contact with the work. Thus, by using the two feeds alternately, the saw finally cut through the plate, the time consumed being five hours and a half.

The vertical feed was then disengaged and the horizontal feed used for the rest of the cut. The cut was continued for a period of six hours and a

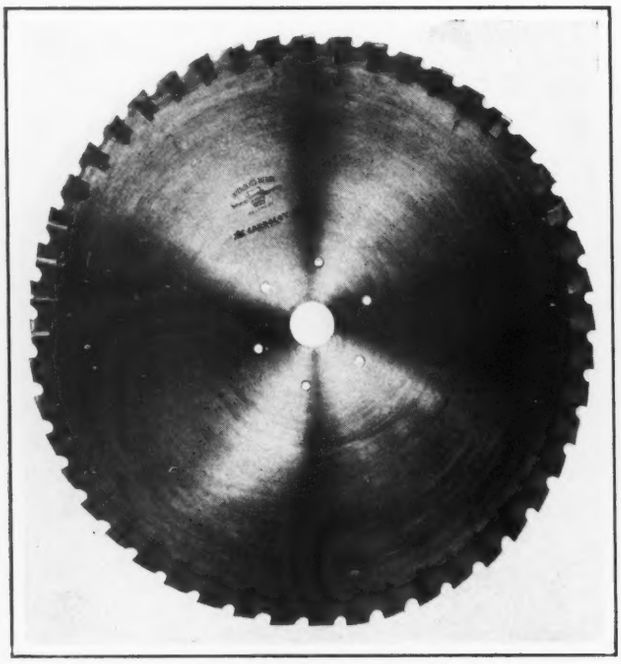


Fig. 2. Carboloy Saw 48 Inches in Diameter Used in Sawing Armor Plate

half, and at the end of this time it was found that the teeth were too dull to cut any more. It will thus be noted that the Carboloy saw had run twelve hours before sharpening was necessary. During this time, the saw had cut vertically to a depth of 16 inches into the armor plate and 61 inches in a horizontal direction. No coolant or lubricant was used, although in another test, it was found that the saw operated better with a lubricant, the teeth remaining free and clean; when the saw was used dry, there was a tendency for the chips to fuse to the teeth. At the end of the test, 0.017 inch was ground off the teeth, and the Carboloy saw was again as good as new.

When the high-speed saw was tested, it was mounted in the same machine and fed vertically into the plate. After cutting for five hours and a half, the saw passed through the work; the vertical feed was then disengaged, the horizontal feed thrown in, and a horizontal distance of 61 inches was cut. At the end of this time, the teeth had become so dull that it was necessary to remove the saw from the machine for resharpening. The use of coolant was found necessary to maintain the cutting action. A total of 14 hours and 10 minutes was required for the vertical and horizontal cuts. Unfortunately, the machine used lacked the rigidity to show the full operating ability of either of the saws, because in order to overcome the chatter, it was necessary to limit the cutting load to suit the machine.

* * *

In 1928, China imported machine tools to a value of about $315,000 of which the United States contributed about $85,000 worth.

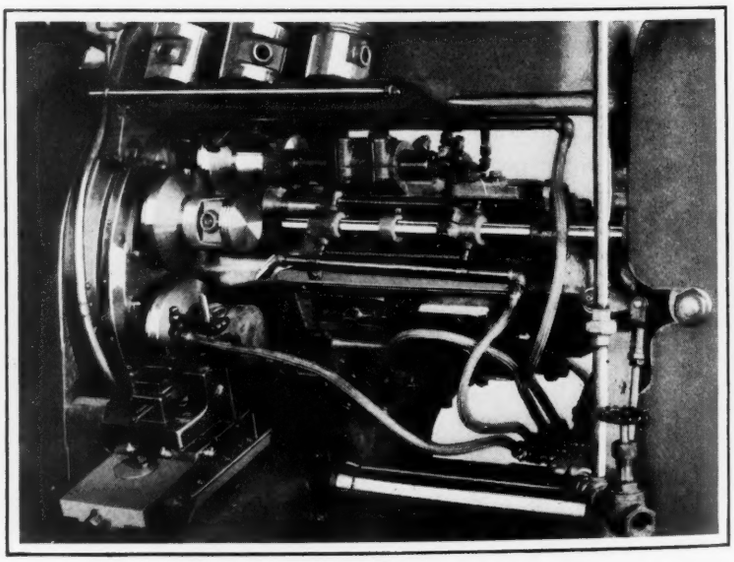
TURNING AUTOMOBILE PISTONS IN A CHUCKING MACHINE

The skirt, grooves, and closed end of automobile pistons are both rough- and finish-turned in one handling as the pistons are successively carried to the five working stations of a chucking machine equipped as shown in the accompanying illustration. This chucking machine was built by the Baird Machine Co., Bridgeport, Conn. In finishing the closed end of the pistons, the tool is removed from the surface in such a way that it leaves no tool marks. The skirt of the pistons is turned to a slight taper. The floor-to-floor time per piston is from fifteen seconds up, depending upon the nature of the material being turned, the size of the piston, the amount of stock removed, the kind of tools used, and the speeds and feeds employed.

The pistons are held in fixtures which have a pin that passes through the wrist-pin holes and a corresponding hole in the fixture. In reloading each fixture, the operator places his foot on a lever near the floor, which withdraws the work locater. He then removes the pin and the piston and locates another piston against a circular part of the spindle face. Next he slips the pin into place and removes his foot from the foot-lever, after which the work locater holds the piston until it is firmly grasped by the automatic holding fixture.

Connected with the work locater there is a safety control by means of which the turret is prevented from indexing while the foot-lever is held down. Besides preventing injury to the operator, this safety control practically eliminates damage of the tools and work.

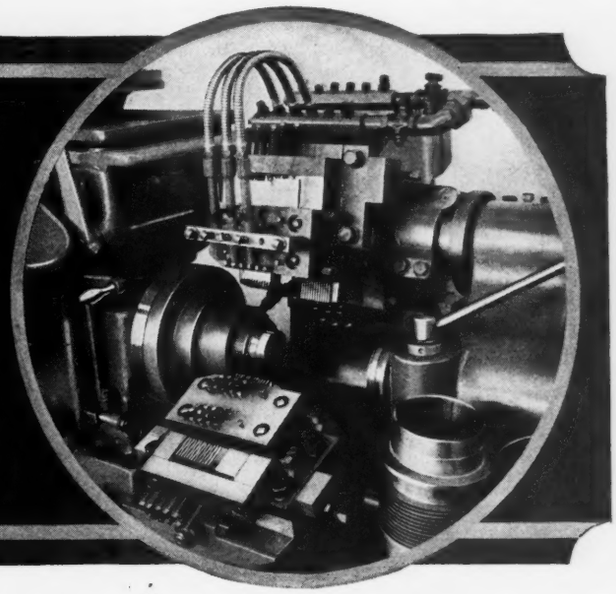
Chucking machines made by the company mentioned can also be provided with a device that automatically stops the machine after an operation cycle and thus prevents the work from passing through the machine a second time in case the operator has not attended to the unloading and reloading. The act of reloading automatically releases the stop in readiness for the next cycle of operations.



Chucking Machine Equipped for Rough- and Finish-turning Automobile Pistons

New Shop Equipment

Latest Developments in Metal-working Machines, Small Tools, and Work-handling Appliances



BARNES AUTOMATIC LATHE WITH HYDRAULIC FEED AND CONTROL

Hydraulic feed and control are important features of a 16-inch automatic lathe being introduced on the market by the John S. Barnes Corporation, Rockford, Ill., a division of the W. F. & John Barnes Co. The driving mechanism of this machine is unusually simple, as will be seen from Fig. 2, which shows a rear view of the machine with the guards for the drive chains and sprockets and the cover of the large motor compartment removed. From the motor, there is a chain drive to the main drive shaft which carries a disk clutch. Power is then transmitted through pick-off gears and herringbone gears to the spindle, there being only two gear contacts in the speed mechanism.

Power for the rapid traverse of both the front and rear slides is obtained from an oil-pump driven by a chain connected to the motor. Power for feeding both of these slides is obtained through pumps driven and controlled by the main spindle. A single lever governs the rapid traverse, and the speed and feed mechanisms are operated in response to the rapid traverse action.

Speed changes are made by changing the pick-off gears, and feed changes by simply turning dials which are graduated to indicate the feed in thousandths of an inch per revolution of the main spindle. The feeds are set independently for the front and rear slides by means of individual dials.

The bed and headstock are cast integral; a wide space is provided in the bed for falling chips, and there is a large opening at the rear to facilitate their removal. The spindle rotates clockwise, which is, of course, opposite to the practice on conventional types of lathes. With this arrangement, the load on the rear tool-slide is downward directly against the lathe bed. The load on the front slide or carriage, while upward, is also directly against the lathe bed, since it is taken by a bar in the bed.

As is apparent from Fig. 1, the front carriage is clamped on and supported

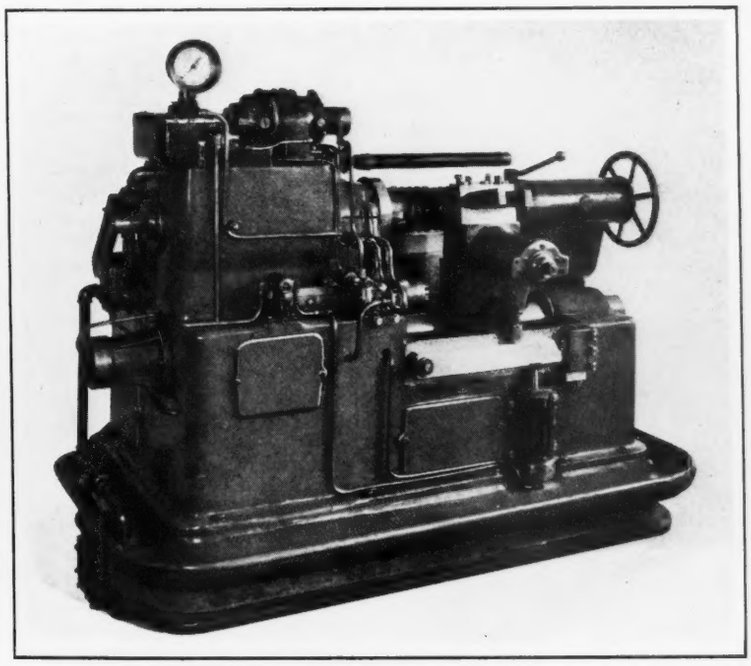


Fig. 1. Barnes Automatic Lathe with Hydraulic Feed and Control

by a 4 1/2-inch diameter bar which is mounted horizontally in bearings in the bed. This carriage is equipped with an adjustable cross-slide which is slotted to receive tool-blocks. Longitudinal feed of the carriage and the bar is direct, the bar being fastened to a piston-rod in a horizontal cylinder at the headstock end of the machine. In-and-out feeding is also direct, the piston-rod of the vertical cylinder on the front of the bed being attached to a guide bar, the other end of which is pivotally mounted on the bed. A roller beneath the carriage runs on this guide bar, and accurate feeding to depth is assured as the guide bar is swung upward against an adjustable stop.

This arrangement provides a universal front carriage which can be employed not only for feeding the cutting tools to depth and for straight turning, but also for turning tapers. Adjusting the stop up or down gives the desired taper, the guide bar being inclined for such operations and held horizontally for straight turning.

The rear tool-slide is bolted on a large flat machined surface, and can be moved longitudinally along the bed to any desired position. The tailstock is also bolted to the same large flat machined surface. A ball-bearing center is provided for the tailstock.

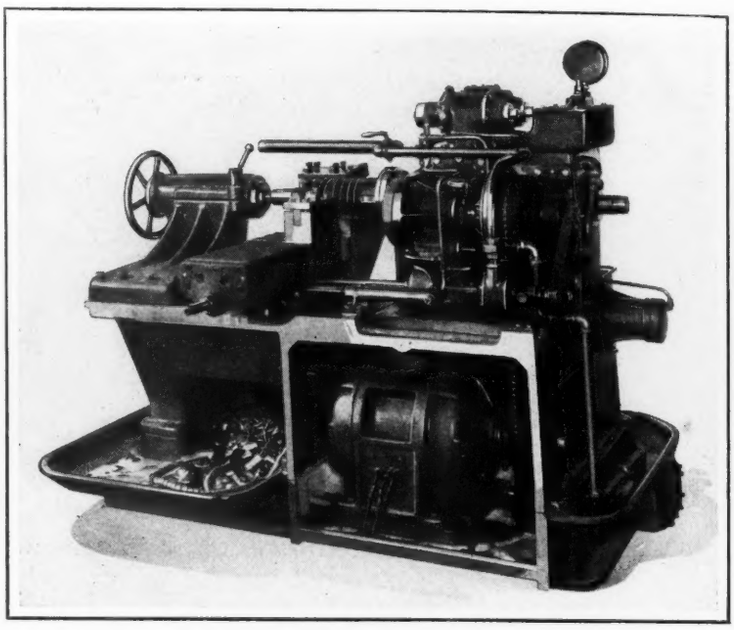


Fig. 2. Drive, Rear Slide, and Tailstock of the Barnes Automatic Lathe

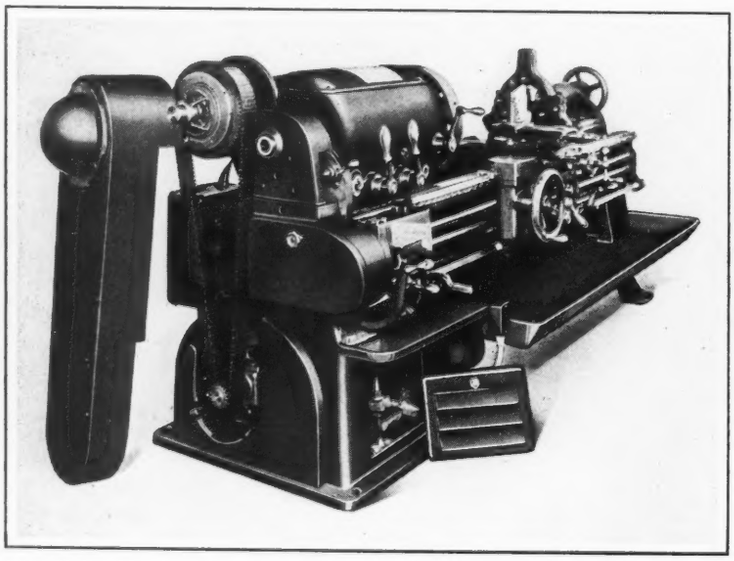
REED-PRENTICE GEARED-HEAD LATHES

Sixteen-inch heavy type and 20-inch lathes now being introduced to the trade by the Reed-Prentice Co., Worcester, Mass., complete the line of sliding geared-head lathes of this company's manufacture. The new machines are similar in design to the 14- and 16-inch regular sizes, which were described and illustrated in June, 1928, MACHINERY, page 798. These machines are adapted for high spindle speeds up to 1250 revolutions per minute to suit the use of tungsten-carbide tools.

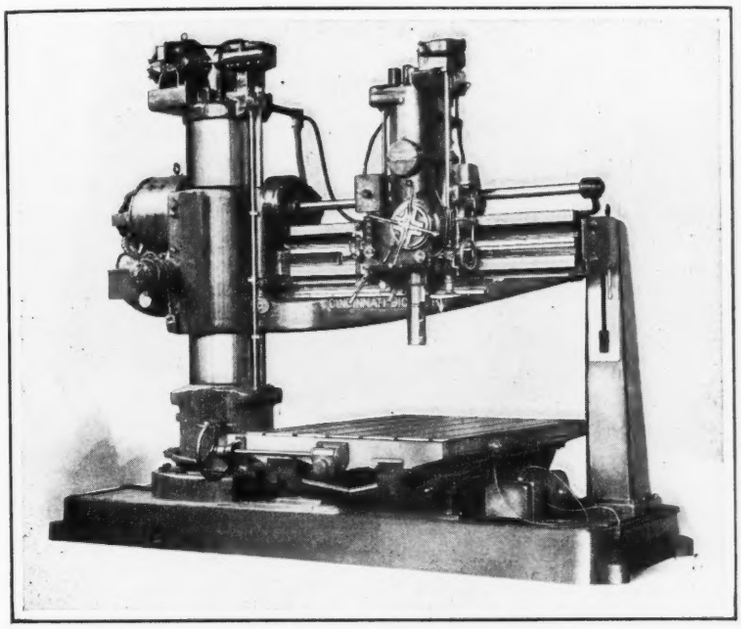
A 15-horsepower alternating-current motor, operating at a speed of 1800 revolutions per minute, can be used with either the 16-inch heavy or the 20-inch machine. The accessibility of the motor and the drive employed for these lathes can be seen from the accompanying illustration.

In the 16-inch heavy machine, the swing over the bed is 17 1/2 inches, over the compound rest, 10 3/4 inches, and over the taper attachment, 9 1/4 inches. Both the headstock and tailstock spindles are machined to fit No. 5 Morse taper shanks. The hole through the headstock spindle is 1 1/2 inches in diameter. The weight of this machine, with a 6-foot bed and standard equipment, is 3750 pounds. Standard bed lengths are 6, 8, 10, 12, and 14 feet.

The 20-inch machine has a swing over the bed of 21 1/2 inches, over the compound rest, 15 1/4 inches, and over the taper attachment, 13 3/4 inches. With an 8-foot bed and standard equipment, this machine weighs 4100 pounds. It is made in lengths of 8, 10, 12, and 14 feet.



Headstock End of Reed-Prentice 16-inch Heavy and 20-inch Geared-head Lathes



Cincinnati Bickford Radial Drilling Machine Equipped for Accurate Drilling and Boring of Jigs and Similar Work

CINCINNATI BICKFORD RADIAL DRILL

The seven-foot radial drilling machine here illustrated has recently been built by the Cincinnati Bickford Tool Co., Oakley, Cincinnati, Ohio, for accurately boring and drilling special printing-press frames. This "Master" radial drilling machine can also be used for boring and drilling large fixtures and die-blocks or machine parts for which it is impractical to make jigs. The machine has a 22-inch diameter column and weighs approximately 48,000 pounds with the equipment shown.

To obtain maximum rigidity, the outer end of the arm is secured to a supporting column and held in accurate alignment. A special jig boring table is located on the base of the machine. It is provided with a power- and hand-operated cross-traverse mechanism and is fitted with a micrometer dial indicator so that accurate final adjustments can be made.

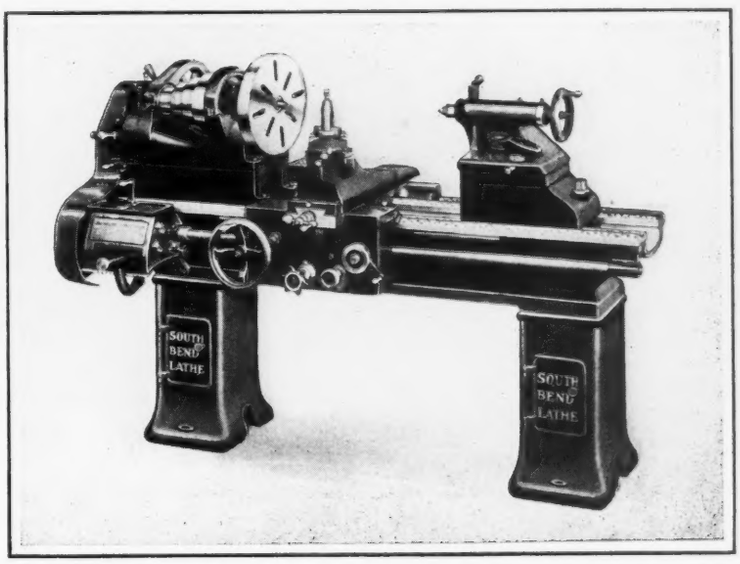
The head moves along the arm at an exact right angle to the cross movement of the table on the base, and the head also is fitted with a micrometer dial indicator, so that precise adjustments can be made. The head can be moved along the arm by a power rapid traverse or by hand. All controls for operating the machine are located on the head. Spindle speed changes are obtained by means of two back-gear levers and a rheostat on the head. A push-button controls the clamping and unclamping of the arm on the column, while a lever under the head controls the vertical movement. The column is clamped by means of a special torque motor which is operated by a push-button on the head.

For general-purpose drilling, such as is usually handled on a radial drilling machine, the outer arm support and the special jig boring table can be removed. Taper pins are provided for locating them on the base and aligning them, so that they can be easily and accurately replaced.

SOUTH BEND LARGE-SWING LATHE

A 16-24-inch new model large-swing lathe has recently been brought out by the South Bend Lathe Works, 773 E. Madison St., South Bend, Ind., for use in machine shops, repair shops, service stations, or wherever work of large diameter requiring only light cuts is to be machined. This machine, which is shown in the accompanying illustration, is the regular 16-inch lathe fitted with raising blocks to increase the swing from 16 1/4 to 24 1/4 inches over the bed.

The raising blocks are placed under the headstock, tailstock, and compound rest. The raising block provided for the compound rest is graduated on the base to facilitate setting the tool to any angle desired. The machine is fitted with automatic cross and longitudinal feeds and is built especially for the cutting of screw threads. By using a special form

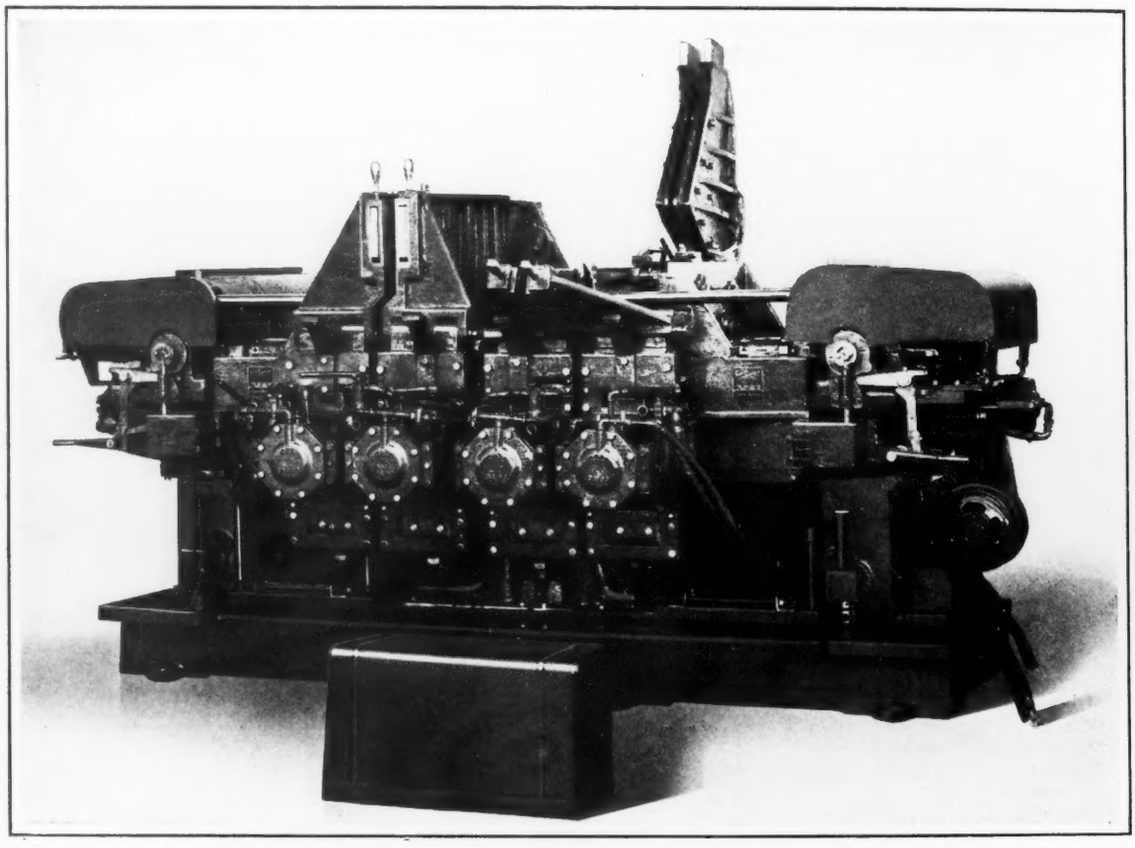


South Bend 16-inch Lathe Equipped with Raising Blocks to Give 24 Inches of Swing

of turning tool, a flywheel 24 inches in diameter can be machined on its face. Either a countershaft or a silent-chain motor drive can be supplied. The machine is made with different lengths of bed ranging from 6 to 12 feet.

TAYLOR-WINFIELD PRODUCTION TYPE WELDING MACHINE

A welding machine designed primarily for making automobile trunks has recently been built by the Taylor-Winfield Corporation, Warren, Ohio. The trunks consist of two stampings or sheet-metal ends which are electrically resistance flash-welded to a central piece. Both ends are welded at once, at the rate of from 60 to 100 trunks per hour. A typical trunk is shown in the illustration at the front of the machine.



Taylor-Winfield Welding Machine Designed Primarily for Welding Automobile Trunks

The equipment consists of two separate welding machines which are mounted on one base and are arranged to act in unison. They are equipped with air clamps operated by toggles, and each machine is motor-driven through a silent chain and gears. The upsetting is accomplished by means of two identical cams which actuate two rollers mounted on the slide. After the pieces have been welded in one unit and the unclamping is accomplished, the slides are returned to the starting position pneumatically. The equipment weighs about 11 tons.

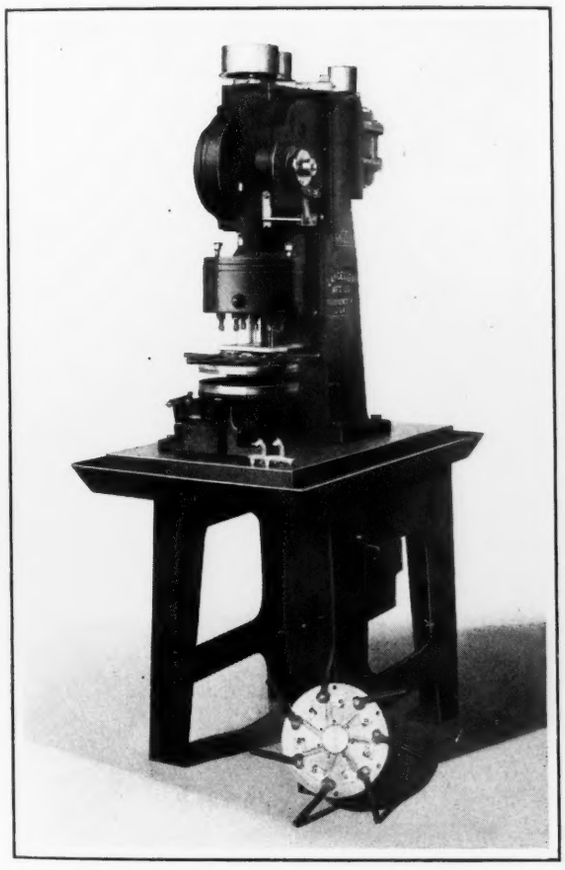
The welding cycle is as follows: After the two end stampings are dropped into aligning fixtures and the central piece is placed in position, four clamping arms are brought down, the latches are thrown into position, and air valves are turned on to effect the clamping. The trip-levers at each end of the machine are then operated and the automatic flashing mechanism is started. When the flashing and upsetting have been completed, the arms are released, the latches are dropped down, and the arms are swung up out of the way. The trunk can then be removed, and a turn of an air cylinder valve causes both slides to move back to the starting position ready for reloading. Two continuous-duty welding transformers of 250 kilovolt-ampere capacity are provided.

LANGELIER SEMI-AUTOMATIC DRILLING MACHINE

A machine for semi-automatically drilling and reaming two 1/8-inch holes spaced 3/8 inch apart in two types of die-forged brass ball-float levers has recently been brought out by the Langelier Mfg. Co., Providence, R. I. This machine is designed to drill and ream ten levers per minute. The machine consists primarily of a standard No. 21 automatic drilling unit mounted vertically on an upright column that is bolted to the machined

top surface of a horizontal table. The automatic drilling unit is equipped with a drilling and reaming head having eight spindles, there being four spindles for each type of lever. This eight-spindle head is used in conjunction with a seven-station automatically operated circular indexing dial which is also bolted to the table.

The dial is operated by a face cam on the drilling unit which is connected by levers and a connecting-rod to a pawl and ratchet wheel on the indexing fixture. A positive lock is provided for accurately locating and holding the dial in position. The indexing fixture has two separate interchangeable dial plates, one for each type of ball float lever. Each dial plate is fitted with seven hand clamping levers, V-blocks, and stop-blocks for locating and holding the float levers. Accurate starting of the drills is accomplished by means of a stationary guide plate. The machine is belt-driven by a 1 1/2-horsepower motor attached to the rear of the column. It can be run continuously or started and stopped for each drilling cycle. A feeding cam gives the drills a fast advance to the work, the proper drilling feed and a fast return movement. The machine occupies a floor space of 28 by 44 inches, and weighs about 1800 pounds.



Langelier Semi-automatic Drilling Machine Provided with Interchangeable Dial Plates

BOLENDER GEAR-TOOTH BURNISHERS

The City Machine & Tool Works, 1517-1531 E. 3rd St., Dayton, Ohio, has recently developed three gear-tooth burnishing machines to suit a wider range of work than can be handled by the previous model built by the concern. One of the new machines, the Model 1, is identical in design to the previous machine, except that it is provided with an electrical control of a type that will be described in the following. The Model 0, which is illustrated in Fig. 1, is a small machine adapted for handling gears from 1/4 to 2 1/4 inches outside diameter and up to 1/2 inch face width. The Model 2, which is illustrated in Fig. 3, has a capacity for gears from 1 1/2 to 14 inches outside diameter and up to 2 1/2 inches face width. Cluster type gears are readily handled on this machine. With slight modifications in design, both machines can be arranged to handle larger gears.

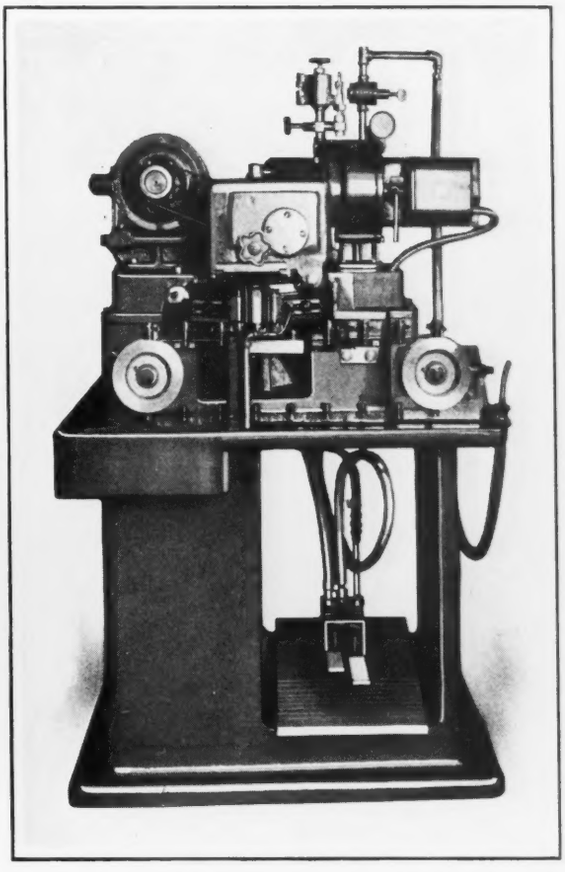


Fig. 1. Bolender Gear-tooth Burnisher for Gears from 1/4 to 2 1/4 Inches Diameter

In Fig. 2, which shows a close-up view of the Model 0 machine, the burnishing rolls are seen with a gear in place between them. The loading of the small gears handled by this machine is considerably facilitated by the belt conveyor seen in the fore-

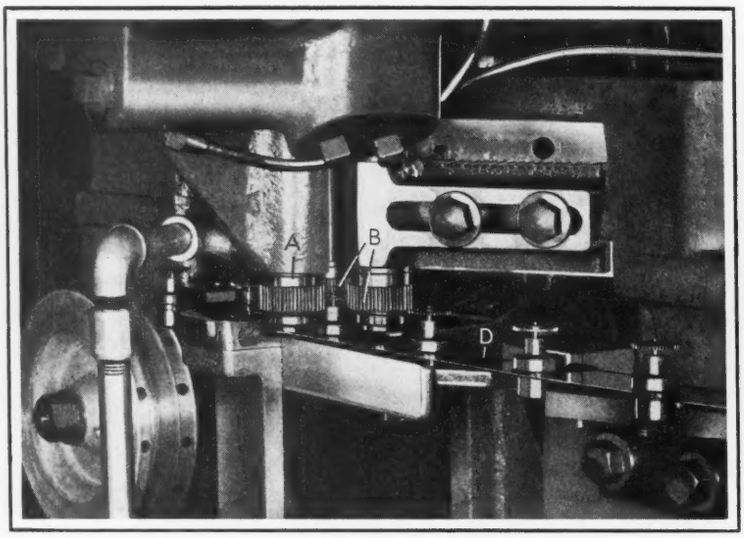


Fig. 2. Burnishing Rolls and Work on the Machine Shown in Fig. 1

ground, and production rates are substantially increased with this device. It will be seen that there are three burnishing rolls, which are made of hardened steel. Roll *A* is rotated by power and is carried on a fixed center, while the two rolls *B* are loosely mounted on their spindles. The latter rolls are carried on a slide and may be withdrawn by pushing down on the left-hand pedal seen at the bottom of the machine in Fig. 1.

When this pedal is depressed, it also causes a link mechanism to pull the conveyor belt *D* forward and carry a new gear a trifle past the proper point for engagement with the burnishing rolls. Then when the pedal is released, the slide that carries the rolls moves forward and at the same time the link mechanism pushes the conveyor belt back against a stop, so that the gear is accurately located between the three burnishing rolls.

The right-hand pedal at the bottom of the machine is next depressed to trip an air valve which actuates a piston connected to the slide on which the burnishing rolls are mounted. In this way a load is placed on the gear, thus rapidly producing good bearing surfaces on its teeth. As it is important that this pressure shall not be too great, provision is made for obtaining the desired load through a regulating valve which holds the pressure to the desired amount indicated on a dial gage at the top of the machine. At the back of the slide on which rolls *B* are mounted, there is a micrometer stop by means of which accurate settings can be readily obtained.

To provide for burnishing both sides of the gear teeth, it is necessary to reverse the direction of gear rotation while the operation is in progress. This is accomplished by means of an electrical control operated through a switch on the front of the machine. After the driven burnishing roll *A* has run a specified number of revolutions in one direction, a mechanical tripping device throws a drum type switch, which operates in conjunction with a magnetic switch. This reverses the direction of rotation of the burnishing rolls and the gear. When the same number of revolutions has been made in the other direction, the switches are again tripped automatically to stop all rotation.

Fig. 4 shows a close-up view of the burnishing rolls provided on the Model 2 machine with a gear in place between these rolls. Gears handled by this machine are inserted through an opening in the cover and placed on a mandrel. Burnishing roll *I* is driven by power, and the two burnishing rolls *J* are loosely mounted on spindles which are carried by a slide. Adjustment of this slide for center distance is accomplished through the application of a crank to shaft *K*. Vertical adjustment of the gear-holding mandrel is effected through screw *L* which is turned by means of knob *M*. The arrangement of the electrical re-

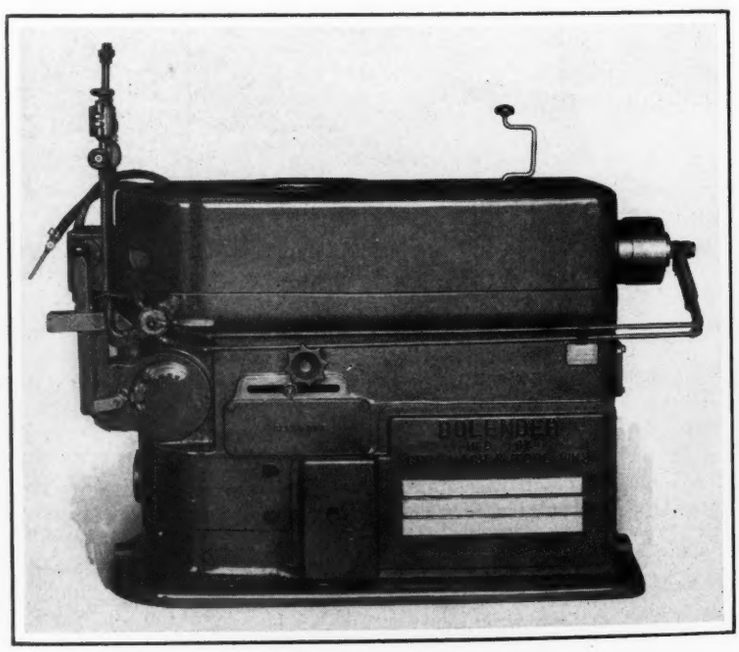


Fig. 3. Gear-tooth Burnishing Machine which Handles Gears up to 14 Inches Outside Diameter

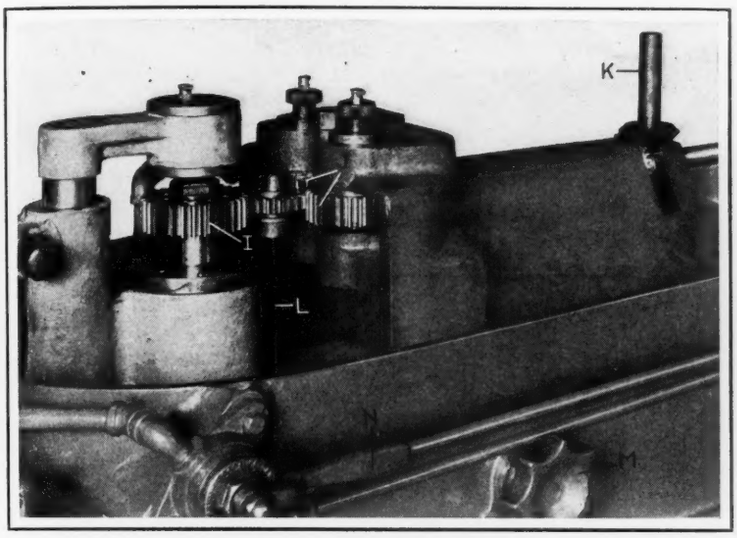


Fig. 4. View Showing Burnishing Rolls and Work on the Machine Illustrated in Fig. 3

versing mechanism is the same as that on the Model 0 machine. The air valve by means of which pressure is applied to the burnishing rolls is shown at *N*.

Both machines here illustrated are furnished with an automatic lubrication system and anti-friction bearings for all rotating members.

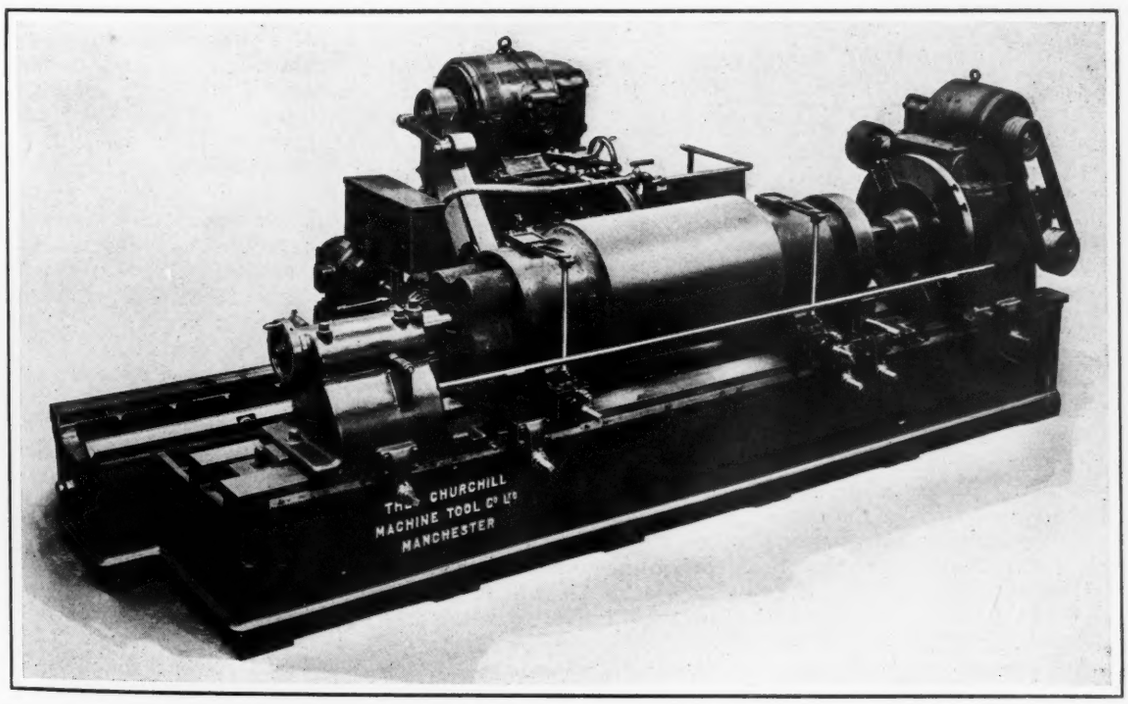
A No. 3 size has been added to the line of Bolender gear grinding chucks made by this concern. The new size is of the same design as the larger size illustrated in September, 1928, MACHINERY, page 64. It is made in three power-operated types, which accommodate gears having up to 51 teeth of 6-8 diametral pitch, and in two hand-operated types, which take gears having up to 31 teeth of 6-8 diametral pitch.

CHURCHILL ROLL-GRINDING MACHINES

Roll-grinding machines with a maximum swing of 40, 60, and 72 inches, respectively, have been brought out by the Churchill Machine Tool Co., Ltd., Broadheath near Manchester, England. Among the principal features claimed for these machines are a hydraulically operated traverse mechanism; a patented cambering mechanism for producing concave or convex surfaces; protected bed ways; independent motor drives for the grinding wheel, work-head, and traverse mechanism; a quick wobbler-drive connection; and V-type adjustable journal rests.

The bed is a one-piece casting with ways protected from dust, other foreign matter, or falling objects, by flat steel plates which are supported above the ways on short studs. Lubricant is delivered automatically to the ways by a number of oil rollers located at intervals along the length of the machine.

The grinding head consists of three principal members, the carriage, cross-slide, and wheel-head. To minimize the pressure between the carriage and the



Churchill Roll-grinding Machine with Hydraulic Traverse Mechanism for the Wheel Carriage

ways, so as to reduce wear, the over-all length of the carriage has been made 9 feet. From his position on the operating platform, the operator has a clear view of the point of contact between the grinding wheel and the roll being ground.

Power for actuating the carriage is transmitted from a separate motor through a Hele-Shaw hydraulic mechanism. An infinitely variable range of speeds is available from the slowest wheel truing speed up to the maximum of 10 feet per minute. In grinding concave or convex surfaces, the solid support is disengaged and the outer end of the slide is carried by the cambering mechanism. Fine wheel feeds are obtained by a hand-wheel graduated to 0.000125 inch.

The work-head is equipped with a special safety device which prevents it from slipping, even when carrying the heaviest rolls, in case the clamps loosen. From the work-head motor, power is transmitted to a four-speed gear-box through a quadruple "Texrope" drive. From the gear-box, the power is delivered to the faceplate driving worm by a silent chain and gears.

The cambering mechanism employs a straightedge as a means of deriving the necessary motion. The degree of inclination of the straightedge from the horizontal plane determines the amount of concavity or convexity produced.

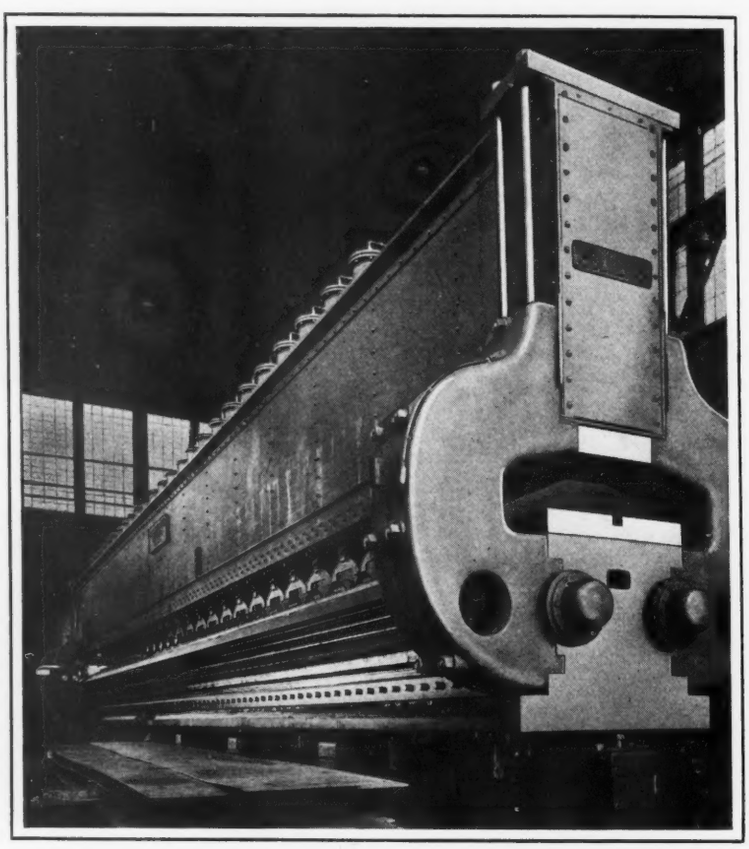


Fig. 1. Sellers Machine which Trims Both Edges of Steel Plates Parallel, Ready for Welding into Pipe

SELLERS DOUBLE PLATE-TRIMMING MACHINE

Steel plates used in the manufacture of welded pipe for natural gas and oil lines are trimmed on both edges simultaneously by the machine here illustrated, which was recently built by William Sellers & Co., Inc., Philadelphia, Pa., for the Republic Iron & Steel Co. Pipe for this purpose varies in diameter from 8 to 16 inches and is made by straight-line production methods. The machine illustrated receives the plates directly from the rolling mill and prepares them for the succeeding operations. Each plate is drawn into the machine through an opening in the frame at one end, is trimmed, and then ejected through a similar opening at the opposite end, ready for welding, rolling, facing, etc. Only two strokes or movements (one cutting and one return) of saddles on opposite sides of the machine are required to complete the cycle in which both sides of the plates are trimmed parallel. The method employed reduces the plates to the proper width, irrespective of their original or rough width.

The machine is 74 feet 4 inches long over all, 13 feet 2 inches high, and weighs approximately 315,000 pounds. It will trim plates up to 50 inches long, from 1/4 to 1/2 inch thick, and from 31 to 55 inches wide in the rough. Power is supplied by a 250-horsepower reversing 3-to-1 motor which gives cutting speeds of from 30 to 75 feet per minute and return speeds of from 30 to 90 feet per minute. The machine consists of a long cast-iron bed with a deep steel girder above for holding the clamping mechanism. Each saddle travels the full length of the bed, and is equipped with a tool-slide and operator's platform. Both of these saddles may be seen in Fig. 2, which shows a view taken through the opening in one of the end frames. Grippers are also incorporated in the saddles for drawing the plates into the machine from one end, and stops eject the finished plates through the opening at the opposite end.

The top surface of the bed is provided with renewable hardened and ground steel plates on which rest long adjustable blocks. These blocks can be moved to and from the center of the bed, as shown in Fig. 2, in order to support plates of varying widths close to the point of cut. To reduce friction when the plates are drawn into position, these blocks are equipped with steel balls,

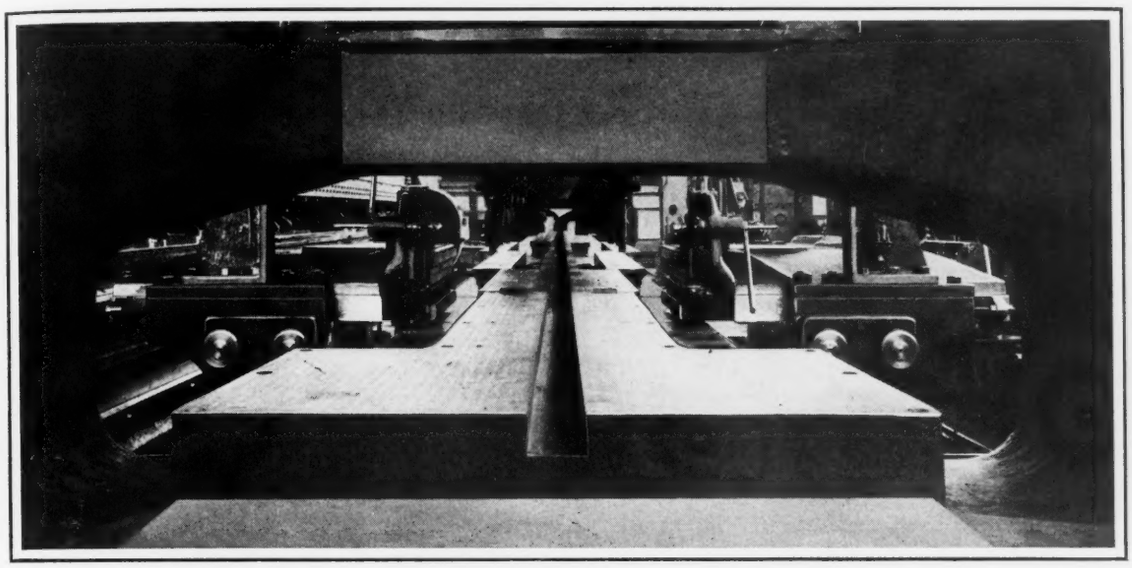


Fig. 2. Looking into the Frame Opening through which the Rough Plates are Pulled for the Trimming Operation

fifty-two in all, which extend slightly above the surface of the blocks. The balls are supported by springs so that when clamping pressure is exerted on the plates from above, they are depressed.

The plates are clamped in position by fifty air jacks mounted on the steel girder. These jacks are arranged in two rows, and are actuated by air cylinders located at the top of the girder. Each jack exerts a pressure of 5000 pounds, giving a total of 250,000 pounds pressure on each plate being machined. A rod running the full length of the machine, equipped with convenient handles, controls eight air valves which supply the cylinders. Each jack has a two-point adjustable clamp, as may be clearly seen in Figs. 3 and 4, which can be swiveled to suit either narrow or wide plates.

Each of the saddles is driven by a large individual lead-screw, and is carried on ways (one above and one below the screw) which are lined with hardened and ground steel wear plates. The adjustable tool-slides of both saddles are arranged to receive thirty-two tools, sixteen of which are mounted in a manifold holder above the plate, and sixteen below, as shown in Fig. 3. The leading tools take broad shallow cuts, while the succeeding tools take narrower and deeper cuts until the plate is trimmed through completely by the last two overlapping tools. The tool manifolds can be easily removed by loosening one bolt, and replaced by another set. Individual set-screws are provided for adjusting each tool.

When a plate is delivered to the receiving end of the machine, the saddles are run to that end

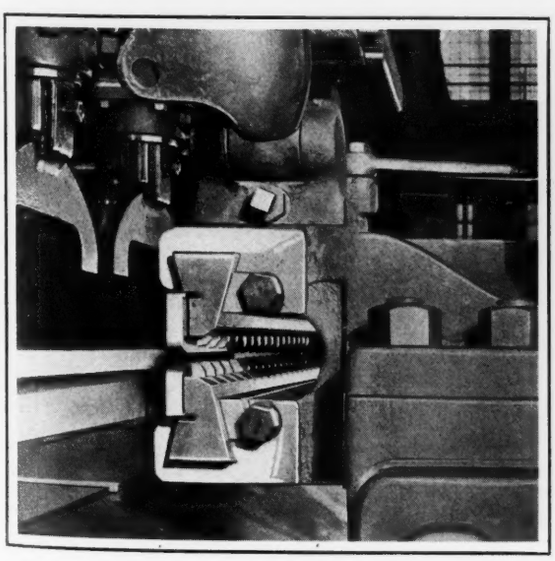


Fig. 3. Close-up View of One Set of Tool-holders with Thirty-two Tools

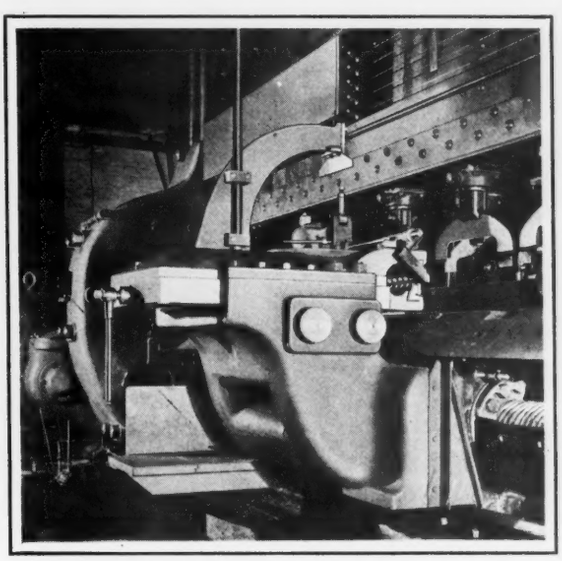


Fig. 4. View Showing One of the Saddles, the Lead-screw and Air Clamps

and the grippers on each tool-slide are fastened on the plate. Then, by reversing the saddles, the rough plate is pulled into position. At the same time, the push-off stops on the opposite side of the tool-slides eject the finished plate. When the grippers are released, sufficient clearance exists between them to permit their free passage over the plate as the saddles are fed for the cutting stroke.

The irregular strips trimmed from the sides of the plates are removed by twelve push-off cylinders located between the adjustable blocks on which the plates are supported. These strips, together with the chips, slide down inclined sheet-metal plates and drop clear of the screws and ways. The saddles are cored out so that the chips fall to the floor, the scrap thus accumulated being carried away by a belt conveyor which is separate from the machine.

The motor, which may be seen at the left in Fig. 4, is equipped with a Cutler-Hammer control. Push-button stations are located on each saddle opposite the operator's platform. Power is transmitted from the motor through a flexible coupling to a set of herringbone reduction gears and spur gears. These, in turn, drive the two lead-screws in unison. The shafts in the gear train are mounted on S K F ball bearings, and the end thrust of the screws is taken by special Rollway roller thrust bearings. The screws are 67 1/2 feet long and are threaded for a length of 59 feet. They are 6 15/16 inches in diameter and have six threads of 7 1/2 inches lead. Each saddle nut is 36 inches long.

MORTON SHAPER ATTACHMENT FOR MACHINING LOCOMOTIVE STOKER BOXES

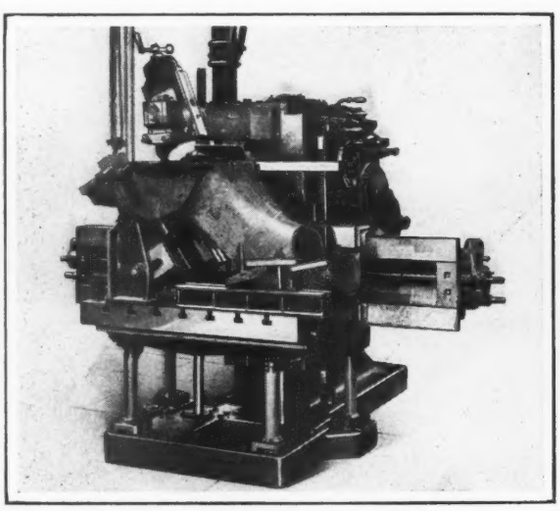
A special tilting attachment has been designed by the Morton Mfg. Co., East Broadway and Hoyt Sts., Muskegon Heights, Mich., for machining locomotive stoker discharge box castings on the 48-inch stroke draw-cut shapers made by this concern. Five shaping operations are required on these castings, all of which are performed at different angles. The illustration shows a casting mounted on the fixture in position for one of these operations. With the shaper and its attachment, the work can be handled much more rapidly than by the methods previously used. The attachment can be removed when it is desired to use the shaper on regular production work.

The 48-inch stroke shaper, which is a heavy-duty machine, has a horizontal or side feed of 60 inches. The vertical feed is 27 inches, and the distance between the ram and the lower table 41 inches. Power rapid traverse is available for both horizontal and vertical movements. The machine has four self-adjusting screws, which are designed to insure accurate alignment of the work for raising and lowering the table. The machine is driven by a variable-speed transmission which provides twenty speeds.

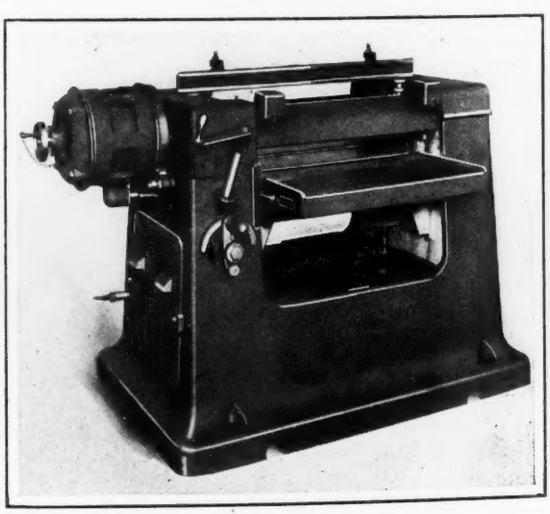
FAY & EGAN SINGLE-CYLINDER SURFACER

A single-cylinder wood surfacer suitable for use in patternmaking shops has been added to the "Lightning Line" of machines built by the J. A. Fay & Egan Co., (Oakley), Cincinnati, Ohio. This surfacer will take material up to 24 inches wide. The table is adjustable 6 inches vertically, and can be raised and lowered by means of heavy screws which are equipped with ball thrust bearings. The lever that adjusts the table, the safety switch, the start-and-stop push-button control, the feed-change lever and the thickness scale, are all conveniently located on the operator's side of the machine.

The feeding mechanism is provided with four rolls, the upper in-feed roll being fluted. Two feeds of 15 and 25 feet per minute are available, and these can be changed while the machine is feeding or running idle.



Morton Draw-cut Shaper with Attachment for Machining Stoker Boxes



Fay & Egan Single-cylinder Surfacer for Use in Patternmaking Shops

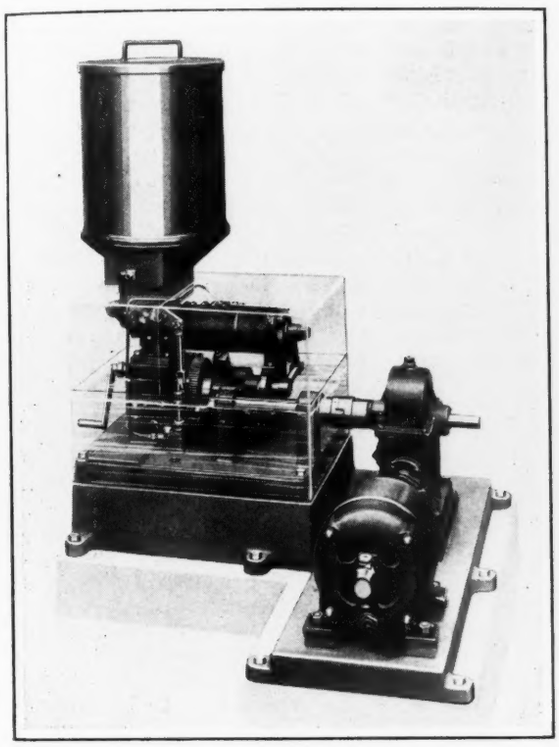


Fig. 1. Anderson Grease Pump which Provides a Positive Means of Feeding Grease to Bearings

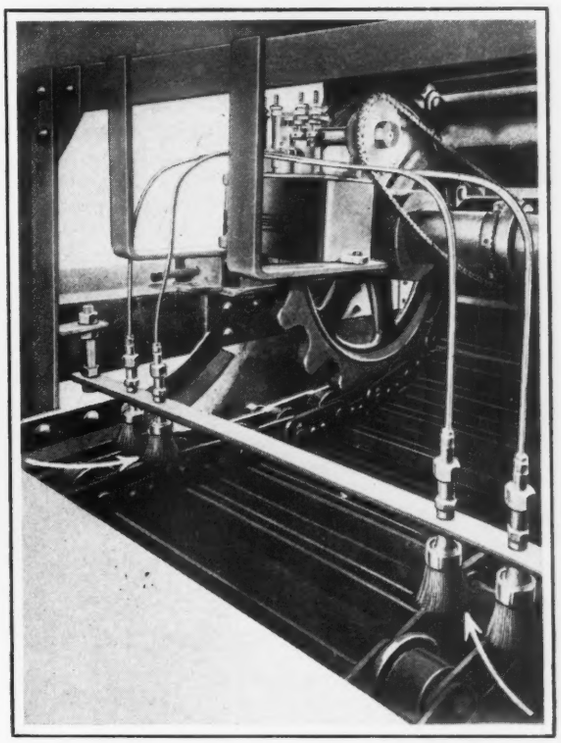


Fig. 2. Hills-McCanna Force-feed Lubricator Used on Apron Conveyor for Lubricating the Chains

HILLS-McCANNA GREASE AND OIL LUBRICATORS

To provide a positive means for feeding grease to machine bearings, the Hills-McCanna Co., Chicago, Ill., has placed on the market the Anderson mill type grease pump shown in Fig. 1. The grease is introduced into the feeding system of this pump by means of a displacement pump having a positive mechanical valve, which is opened on the suction stroke and closed prior to the discharge stroke. A distributor head with the requisite number of leads is directly connected to the discharge side of the pump. Indexing of the head is accomplished by a ratchet attachment, which functions on the suction stroke of the pump and remains fixed during the discharge stroke, after which it indexes the distributor to the succeeding lead.

Delivery lines attached directly to the distributor head lead to the bearing connections. A steam heating element is installed on the bottom of the hopper casting directly above the intake valve to facilitate the handling of heavy grease during cold weather. The hopper of the equipment illustrated has a capacity of approximately 50 pounds, but other sizes are available. The stroke of the pump can be adjusted to regulate the amount of grease delivered, and the speed of the drive can also be adjusted. The grease pump is built in various sizes according to the number of feeds required. It has sufficient capacity for delivering grease under any bearing pressure up to a maximum of 5000 pounds per square inch.

Fig. 2 shows an adaptation of a Hills-McCanna force-feed lubricator for oiling a heavy-duty apron conveyor. The lubricator is mounted on the under or slack side of the conveyor, and oil is forced by the pump through 1/4-inch copper tubing to brushes that are in contact with the conveyor chain. As each link in the chain passes beneath the brushes, it is coated with a film of oil. Lubricators of this type are built in units having as many as sixty feeds. These units can be mounted in tandem and operated by a central driving member.

CINCINNATI MILLING MACHINES

Two machines, known as the "New No. 4 plain and universal" have been added to the line of milling machines built by the Cincinnati Milling Machine Co., Cincinnati, Ohio. These machines have the same general characteristics as the No. 3 machines described in the November, 1929, number of MACHINERY. On the new machines, the table has a working surface of 75 by 16 inches, a longitudinal movement of 42 inches, and a cross movement of 14 inches. The vertical movement is 20 inches on the plain model and 19 inches on the universal. The net weight of the plain machine with a belt drive is 8400 pounds, and of the universal machine, 8700 pounds.

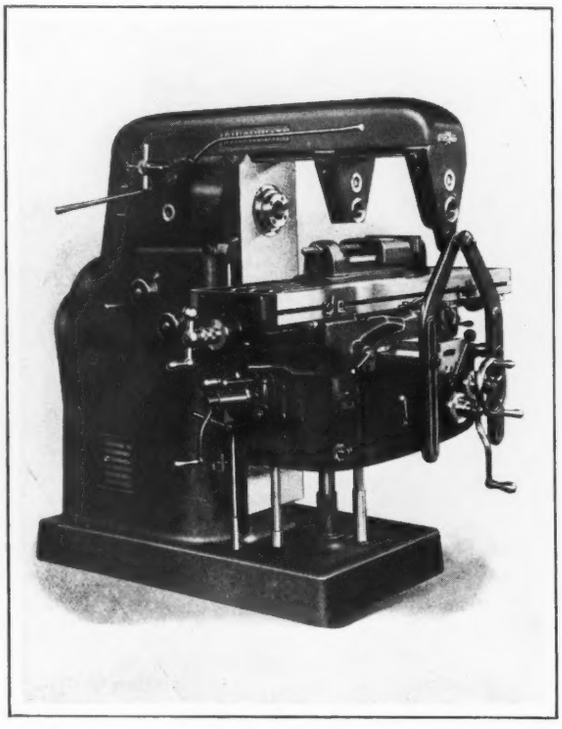
Sixteen spindle speeds ranging from 14 to 450 revolutions per minute, and sixteen table feeds ranging from 3/4 to 30 inches per minute, are obtainable by

means of an automatic power shift mechanism controlled from either the front or the rear. Independent directional control levers for the cross, vertical, and horizontal movements of the table, either in or out, up or down and to the right or left, are provided. There is a power rapid traverse for each of these movements with the spindle stopped or running.

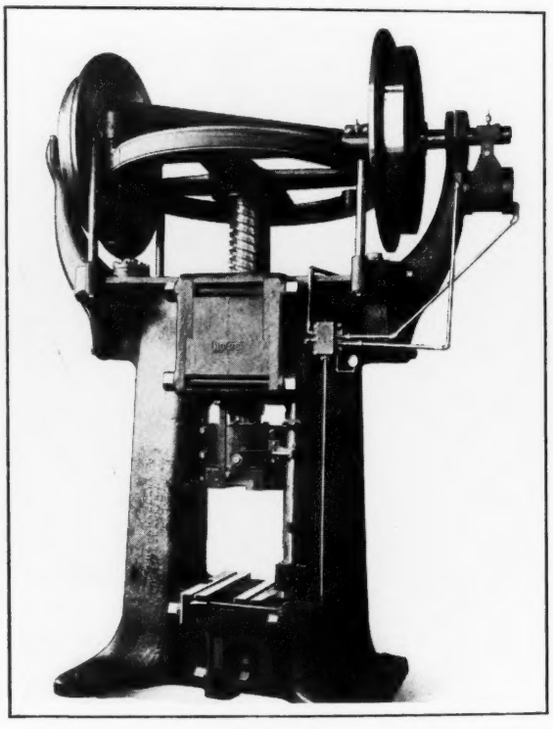
The mechanism within the column is automatically lubricated by a geared pump; automatic lubrication by the use of a pump is also provided for the knee; and a one-shot lubrication system is furnished for the saddle and table ways. Anti-friction bearings are used throughout the spindle drive and there is a double mounting of anti-friction bearings at both the front and rear of the spindle, with a floating rear bearing.

Seven more sizes, in both plain and duplex styles, have been added to the line of Hydromatic milling machines built by this company. This gives a range of machines having a table travel of from 24 to 90 inches, with a rating of from 5 to 20 horsepower, there being a variety of combinations in between which makes it possible to obtain a machine with a long table travel and a low horsepower rating.

The characteristics of the new machines are the same as those of the regular Hydromatic which was described in January, 1930, MACHINERY, page 404, and December, 1927, MACHINERY, page 305. These machines are equipped with a Cincinnati locked hydraulic table feed; an automatic dog-controlled intermittent table feed; a power quick traverse of 220 or 300 inches per minute, depending upon the size of the machine; an enclosed motor drive; anti-friction bearings throughout the spindle drive with a double mounting at the front and rear of the spindle; a spindle reverse; cross and vertical adjustments of the spindle; a centralized control at the left front of the machine; and an automatic spindle stop.



Cincinnati No. 4 Milling Machine Built in Plain and Universal Styles



Zeh & Hahnemann Percussion Power Press which Weighs Fifty Tons

ZEH & HAHNEMANN PERCUSSION POWER PRESS

A percussion power press which weighs approximately 50 tons has recently been built by the Zeh & Hahnemann Co., Newark, N. J. While this press —the No. 25—is rated to yield a pressure of 625 tons, a maximum pressure of 1800 tons was obtained under actual test. The main screw, which is made of tool steel and heat-treated, is 14 inches in diameter. The over-all height of the press is 18 1/2 feet, and 50 horsepower is required for its operation.

This machine is designed to produce hot-pressed brass parts, but it is equally well adapted for embossing operations and for the hot- or cold-pressing of steel parts. Steel forgings can be made with one blow.

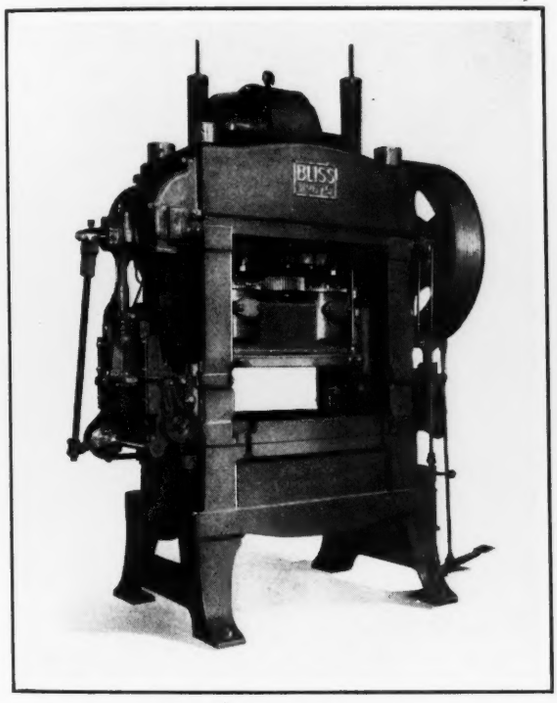
The press is provided with a pneumatic control and is easily operated. It reverses automatically at the end of the down stroke and stops in the up position. The maximum length of stroke is 22 1/2 inches, and a speed of up to ten strokes per minute is obtainable. Slide and bottom knock-outs are furnished for ejecting the finished pieces quickly from the dies.

BLISS DOUBLE-ECCENTRIC HIGH-PRODUCTION PRESS

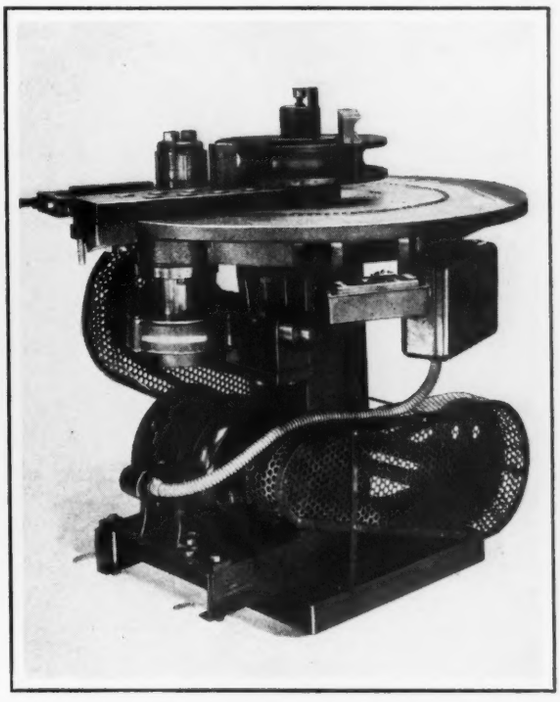
High operating speeds and ample space for long follow-dies are features of the 125-ton double-eccentric press recently added to the line of high-production presses built by the E. W. Bliss Co., 53rd St. and Second Ave., Brooklyn, N. Y. This press, known as the No. 675, has been designed to meet the needs of manufacturers who require an unusually heavy automatic press capable of maintaining accuracy on progressive die work such as is handled in the automobile, radio and electrical equipment manufacturing industries.

The machine is designed to operate at speeds ranging from 150 to 250 strokes per minute. The bolster surface of the standard machine measures 27 inches from the front to the back, and 35 inches from right to left. Dies having a "shut height" up to 8 inches can be used.

The press is equipped with a high-speed double roller-grip feed; a shear-type scrap cutter; a rolling key clutch; and a flexible motor drive. When furnished for feeding strip stock, a mechanical starting gage is provided, which can be operated by a foot-treadle, leaving the operator's hands free to guide the stock. With this equipment, the rollers will automatically feed a piece of stock the full length of the stroke when starting a strip, thus eliminating the cutting of half blanks, burring of stock, and punch breakage. Practically continuous production is possible, as successive strips can be fed between the rollers without interruption. Some of the important dimensions are: Size of the slide face, 15 by 30 inches; adjustment of slide, 1 1/2 inches; standard stroke, 1 and 1 1/2 inches; length of feed-rolls, 15 inches; distance from floor to top of bed, 32 inches; and over-all height of machine without motor, 108 inches. The machine occupies a floor space of 62 by 88 inches and weighs about 15,000 pounds.



Bliss Press Developed for High-speed Operation with Long Follow-dies



Pedrick Pipe Bender with Motor and Drive Mounted below the Table

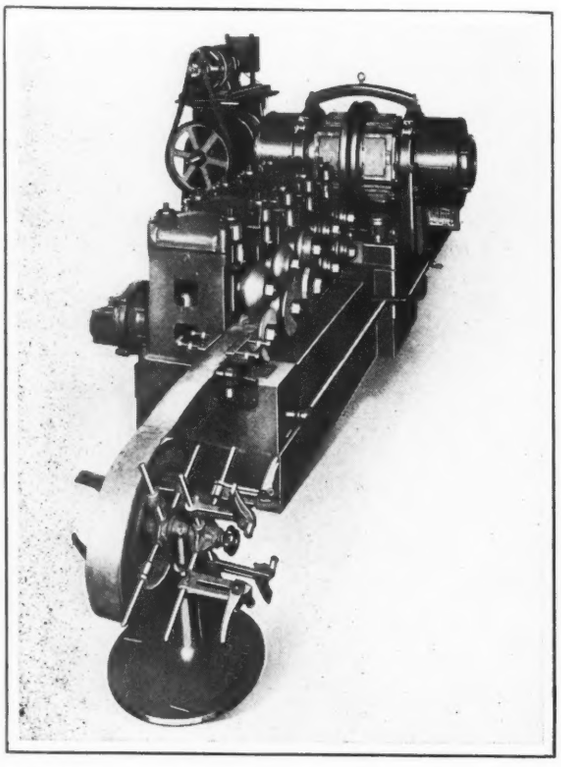
PEDRICK MOTOR-DRIVEN PIPE BENDERS

The line of motor-driven pipe bending machines made by the Pedrick Tool & Machine Co., 3639 N. Lawrence St., Philadelphia, Pa., has been redesigned, the motor and drive now being located below the table, so that the faceplate can be operated through a full 360 degrees. The redesigned machines have all the features found in the regular Pedrick pipe benders, the difference being chiefly in the method of applying the motor drive.

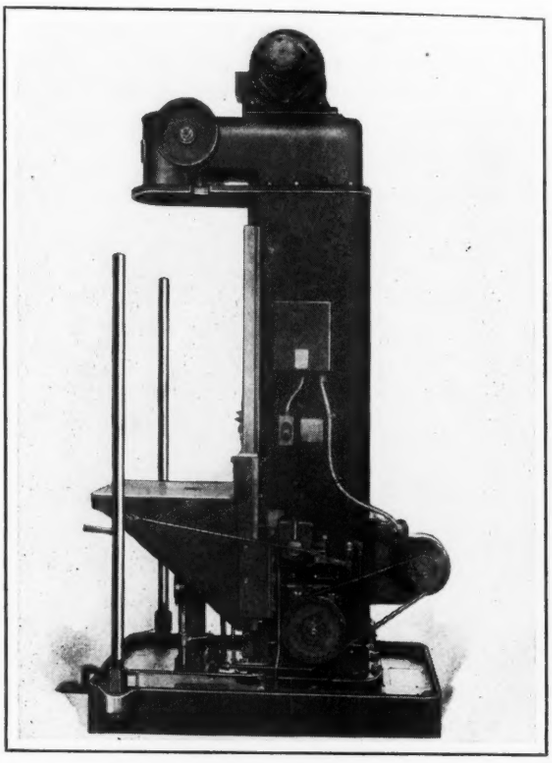
The motor is mounted on the base of the machine and transmits power through a roller chain to a jack-shaft. From the jack-shaft another roller chain delivers the drive to a worm-shaft which engages a vertical worm-wheel shaft. A spur pinion on the vertical shaft engages the gear teeth on the revolving table of the machine, thus transmitting the required motion. A reversing motor is used, provided with a push-button control. This control has three buttons for starting, stopping, and reversing.

DIRECT-CURRENT ELECTRIC WELDING UNIT

An Acyclic generator unit designed to permit the welding of tubing electrically from flat skelp



Direct-current Electric Welding Unit Applied to a Tube-forming Machine



Buhr Multi-head Drilling Machine Equipped with Hydraulic Feed

without leaving "stitches" (a welded spot followed by an unwelded portion) has recently been developed by the American Electric Fusion Corporation, 2610-2620 Diversey Ave., Chicago, Ill. The accompanying illustration shows this generator mounted on a tube-forming machine.

Instead of using alternating current directly for welding, this kind of current is employed for driving the two 35-horsepower motors which are connected to the Acyclic generator. This unit generates current of approximately 2 1/2 volts and is capable of delivering current up to 20,000 amperes.

The arrangement of the generator is such that the welding current is delivered to circular bus bars which surround the stator of the generator, the welding rings being attached to these bars. Thus, while the rotor of the generator rotates at a high rate of speed within the generator frame, the frame itself rotates slowly over the seam of the tube as it passes beneath the generator. The nature of the current being non-fluctuating, the welding temperature is likewise non-fluctuating and so a smooth continuous weld is produced. On preliminary trials, speeds as high as 200 feet per minute have been readily obtained.

BUHR HYDRAULIC-FEED MULTI-HEAD DRILLING MACHINE

A multi-head drilling machine equipped with a hydraulic feed has recently been brought out by the Buhr Machine Tool Co., 839 Greene St., Ann Arbor, Mich. This machine is provided with Timken tapered roller bearings and embodies some of the features of the cam-operated multi-head machine built by the same concern. An Oilgear unit is contained in a separate chamber which is cast integral with the column, and the unit is bolted to the column. A pump mounted on the base is driven by the drive shaft of the Oilgear unit. The motor for this hydraulic equipment is mounted on the back of the column and transmits power through a "Texrope" drive. Oil cylinders of a size to suit the operation, and with the required length of stroke, are provided.

An indexing fixture with any desired number of stations can be furnished, thus enabling the machining time to be cut down so that the loading time governs the operating cycle. Multiple heads can be bolted to the head of the machine, which has a 15-inch flange. For single-spindle work, auxiliary spindle arbors having up to a No. 6 Morse taper, or provided with a special driving means, can be used. The motor for driving the drill spindles is mounted on top of the head and transmits power either through a "Texrope" drive or a silent chain to a gear-box. Pick-off gears provide speed changes.

Some of the principal specifications of this machine are as follows: Width of column across ways, 20 1/2 inches; distance between table and head with standard height of column, 52 inches;

capacity of machine with a 3-inch cylinder, 3 tons; and weight of machine without equipment or motor, about 7000 pounds.

WELLS THREAD-MILLING MACHINE

A thread-milling machine designed to cut the thread on taps with a hob milling cutter, in one revolution of the work, is a recent development of the Wells Mfg. Co., P. O. Box 613, Greenfield, Mass. The machine mills either straight or tapered taps, with or without radial relief, and will handle taps up to the 2-inch pipe size. No lead-screws or lead-nuts are used, the lead being produced by hardened and accurately ground cams mounted directly on the work-spindle.

The tap blanks are driven by their square ends, no dogs or other clamping devices being required. A lever on the head of the machine, which operates the tail work-supporting center, enables the work to be changed quickly. The machine stops automatically when the work is done.

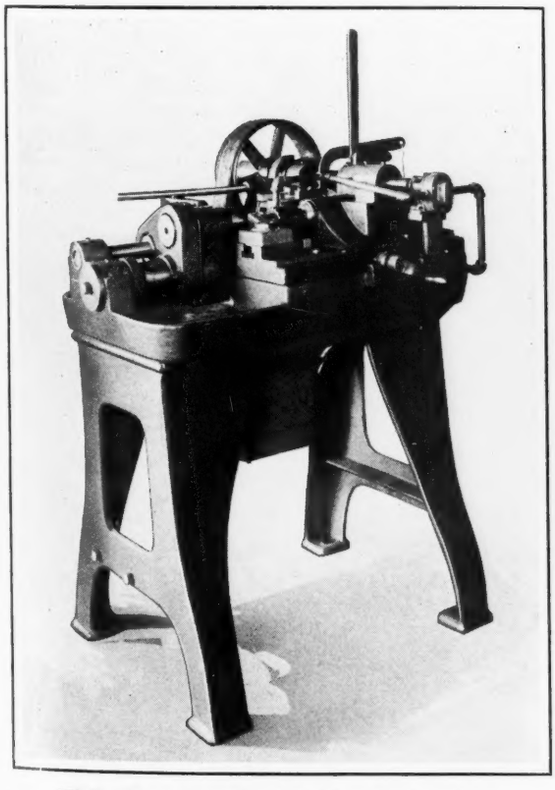
Either an individual motor drive, using a 1/2-horsepower motor, or a single pulley belt drive, direct from the lineshaft, can be employed. Changes in feed are obtained by means of enclosed gears. All worm-gearing is enclosed and runs in oil. A large oil tank with a removable chip tray holds the lubricant, which is delivered to the work by a gear pump. The machine is adapted for installation in groups of four which can be attended by one operator. The weight of the machine is 1200 pounds, and it occupies a floor space of 30 by 36 inches.

RADIAC HIGH-SPEED ABRASIVE CUT-OFF MACHINE

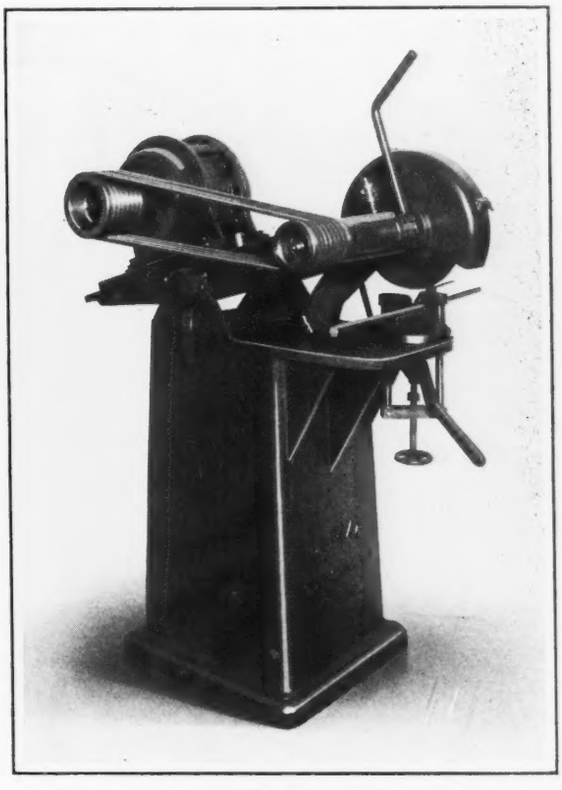
An improved abrasive cut-off machine, known as Type C, is being placed on the market by A. P. de Sanno & Son, 1615-23 McKean St., Philadelphia, Pa. This machine is so constructed and balanced that a speed of 16,000 surface feet per minute can be employed. At this speed, materials up to 2 inches in diameter are cut off at the rate of 1 square inch per second without burning the material. Reduction of burrs to a minimum is another advantage claimed for this high cutting speed.

The machine has a capacity for cutting stock up to 2 inches square or 2 inches in diameter. Steel, brass, copper, aluminum, cast iron, tungsten-carbide, or other materials of like nature can be handled. Metallic materials such as cables, reinforced brake lining, fiber, vulcanized rubber, etc., can also be cut off on this machine.

On the cabinet base is mounted a tilting arm which carries the wheel-spindle. Power is transmitted to the wheel-spindle from a 7 1/2-horsepower motor by means of a multiple V-belt drive. The motor is mounted on an adjustable sub-base for convenience in putting on or removing the seven endless V-belts. A push-button station is provided on the front of the machine for controlling the motor.



Wells Thread-milling Machine Designed for Hobbing Tap Threads



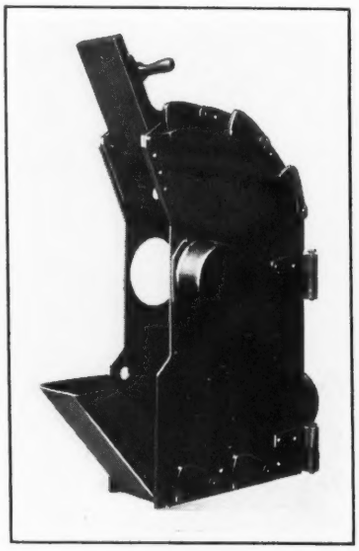
Radiac Cutting-off Machine with High-speed Abrasive Wheel

The wheel-spindle runs in four ball bearings arranged to eliminate side motion. The work is held in a split V-block and is clamped in place by the movement of a cam-lever which applies pressure equally on each side of the cutting wheel. This clamping device can be set for cutting off material at any angle from a right angle to 45 degrees. The machine, including the motor, weighs 1200 pounds.

WESTINGHOUSE RIGHT-ANGLE DRIVE REDUCTION GEAR UNIT

A reduction gear unit like the one shown in the illustration, designed for right-angle drive, has been developed by the Nuttall Works of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. This unit is designed for use with a 10-horsepower motor operating at a speed of 1200 revolutions per minute. The gear ratio of ten to one is obtained through spiral bevel gears in the first reduction and single helical gears in the second reduction.

Timken roller bearings are used throughout, and the gears and bearings are lubricated by a positive splash system. The drive was designed primarily for operating stirring paddles in chemical vats, and to meet the requirements of this service, the lower bearing of the vertical low-speed shaft is provided with a seal designed to prevent oil leakage.



Ransom Wheel Guard for Snagging Grinders

RANSOM GRINDING WHEEL GUARDS

Grinding wheel guards of the type illustrated have been placed on the market by the Ransom Mfg. Co., Oshkosh, Wis., for application to snagging grinders already in use. These guards are made of rolled plate steel. At the top there is an adjustable piece of plate steel, 3/4 inch thick, which is lowered as the wheels wear down in diameter so as to protect the operator against breaking wheels.

The door is hinged and held shut by malleable-iron latches. The exhaust pipe opening is at the back of the guards in such a position that while the bond or dirty part of the refuse is carried off, there is no caking of the refuse in the exhaust pipe. The lower front part of the guards is removable. It is left on when work is being ground on a rest, but otherwise, it is removed so that free access to the wheel is obtained even when the wheel is worn small in diameter.

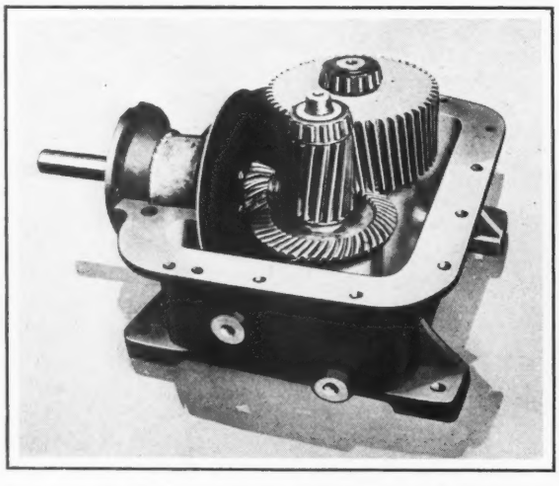
These guards are made in 16-, 18-, 20-, 21-, 24-, 27-, 30-, and 36-inch sizes. They are provided on the machines that were illustrated in February, MACHINERY, page 488.

CULLMAN SPEED REDUCER

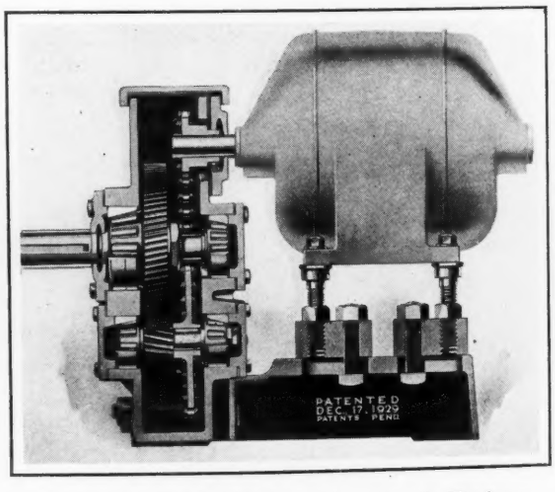
Several improvements have been made in the speed reducer manufactured by the Cullman Wheel Co., 1339 Altgeld St., Chicago, Ill., including the application of Timken roller bearings throughout and the use of helical gears in place of plain spur gears. Quieter operation and more efficient transmission of power are advantages claimed for these speed reducers.

The first reduction is obtained by a chain and sprocket drive, which reduces the first gear contact speed from two to six times the motor speed. This feature not only reduces the wear on gears, but also results in quieter operation. The gears are supported by four Timken bearings.

Improvements have also been made in the oiling arrangement



Westinghouse Reduction Gear Unit with Right-angle Drive



Cullman Speed Reducer Equipped with Timken Roller Bearings

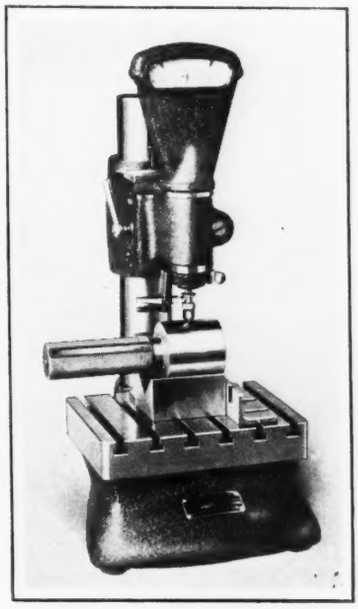
which provides lubrication for the gears, bearings, and sprocket chain. Practically no changes have been made in the over-all dimensions of the speed reducer.

STANDARD ELECTRICAL HIGH-SPEED SNAGGING GRINDER

Grinding wheels of the ring type, from 24 to 30 inches in diameter, can be used on a No. 50 high-speed floor stand grinder which has been added to the products of the Standard Electrical Tool Co., 1938-46 W. 8th St., Cincinnati, Ohio. A 10-horsepower motor is furnished for driving the machine when it is equipped with 24-inch wheels, and a 15-horsepower motor is provided for use with 30-inch wheels.

The work-rests of this machine and the boiler plate hoods with their overlapping covers can be moved to suit any working condition. A safety control device operates in conjunction with the movement of the hoods so as to guard against over-speeding of the wheels, and assures a satisfactory working range of from 7500 to 9000 surface feet per minute. The spindle is 4 inches in diameter by 74 inches long, and is mounted in four S K F ball bearings.

Three speed changes are obtainable by means of three-step V-belt sheaves mounted on the spindle and motor shaft, as illustrated in Fig. 2. The power is transmitted from the ball-bearing motor in the base to the spindle through three Dayton "Cog-Belts." The motor is raised and lowered to change the belt tension by means of a screw.



Societe Genevoise Micro-Indicator Mounted on Stand

SOCIETE GENEVOISE MICRO-INDICATOR SUPPORT

Societe Genevoise d'Instruments de Physique, Geneva, Switzerland, has placed on the market in the United States and Canada, through the R. Y. Ferner Co., Investment Bldg., Washington, D. C., a new form of stand for the Micro-indicator described in the February number of MACHINERY. The base and column of the new stand are designed as shown in the illustration. It is of heavy construction, the column which supports the indicator being 2 inches in diameter. The total weight of the stand, exclusive of the Micro-indicator and the accessories, is 48 pounds.

The table is 5 by 7 inches and is machined flat within less than 0.0001 inch. Two angle-plates and a V-block may be used for supporting cylindrical pieces, as shown in the illustration. The axis of the indicator is 3 3/8 inches from the face of the column. The table can be adjusted or moved forward for a distance of 3/4 inch to increase the holding capacity. The vertical capacity of the apparatus is 6 inches when the spherical contact point on the Micro-indicator is used.

WELLS SHARPENER FOR CUTTER BLADES AND DIE CHASERS

A motor-driven grinding machine for sharpening reamer blades, inserted milling-cutter blades, box-tool blades and die chasers, has recently been developed by the Wells Mfg. Co., P.O. Box 613, Greenfield, Mass. The cup-wheel of this machine is mounted directly on the shaft of a 1/6-horsepower motor which operates on 110- or 220-volt current. The machine has a capacity for grinding blades or chasers of any ordinary width or thickness and up to 4 inches in length.

The work is laid on a flat plate against an adjustable stop, and is held in place by a simple clamp. The work-holding plate

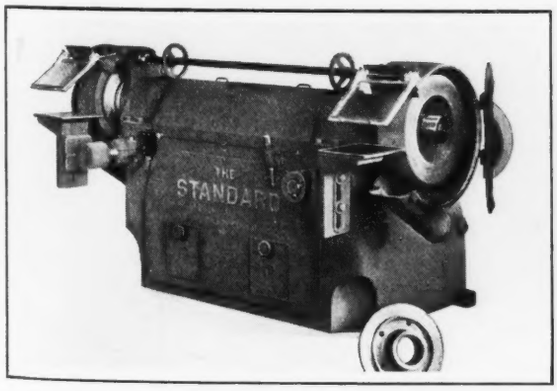


Fig. 1. Heavy High-speed Snagging Grinder Made by the Standard Electrical Tool Co.

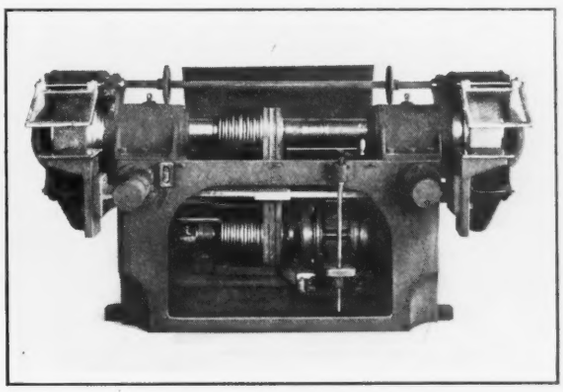
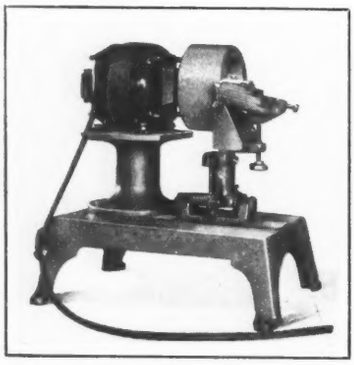


Fig. 2. Driving Arrangement of the Snagging Grinder Illustrated in Fig. 1



Wells Motor-driven Sharpener for Cutter Blades and Die Chasers

can be swiveled to give any desired taper and can be adjusted to grind any bevel on the cutting edge. It swings past the grinding wheel on pivots which are protected from dust and are adjustable for wear. The machine is designed to grind all blades or chasers of a set uniformly.

DAVENPORT IMPROVED SCREW MACHINE

The latest model of multiple-spindle automatic screw machine to be built by the Davenport Machine Tool Co., Inc., 167 Ames St., Rochester, N. Y., is shown in the accompanying illustration. One of the new features is a box base. In the left-hand end of this base there is a compartment for the change-gears, cams, etc., which are accessible through a door at the front of the base.

Another feature of the machine is the system of guards provided. These guards can be swung upward out of the way for adjusting the tools, and then closed as illustrated when the machine is started on production. A new design of conveyor carries the chips to the right-hand end of the machine, where they are discharged into a suitable receptacle.

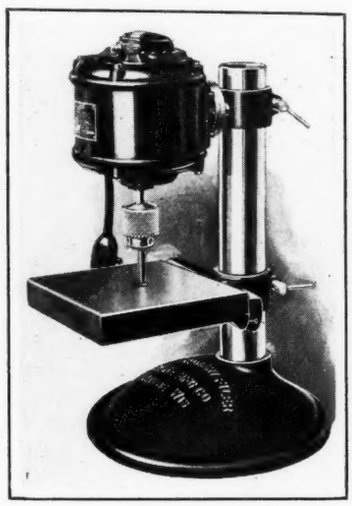
Other construction details of this machine are similar to those of the model described in July, 1929, MACHINERY, page 862.

VACUUM CLEANER FOR INDUSTRIAL USES

A new design of industrial vacuum cleaner of the portable tank type has been placed on the market by the Breuer Electric Mfg. Co., 852 Blackhawk St., Chicago, Ill. This vacuum cleaner is designed especially for heavy-duty work in cleaning machinery, motors, overhead pipes, girders, walls, and floors in industrial plants. The motor can be removed from the cover and used as a portable blower.

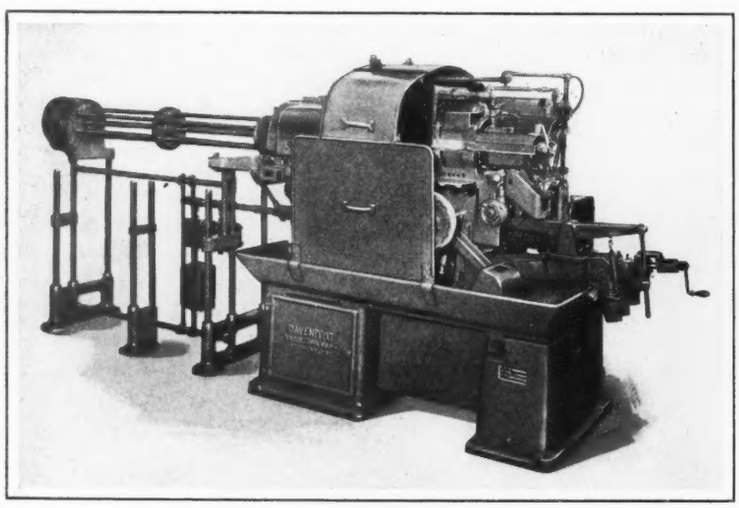
RAUSCH ROTARY DIE-FILING MACHINE

A rotary die-filing machine, designed for use in making blanking and irregular-shaped dies, templets, sheet-metal parts, irregular-shaped gages, cams, etc., has been brought out by the Rausch Mfg. Co., 401 Lake Ave., Racine, Wis. This machine is also adapted for finishing formers for profiling and for filing master templets for engraving machines. A punch of any contour can be relieved by using a Type B rotary file having the cutting teeth projecting beyond the shank an amount equal to the desired clearance. The shank thus serves as a stop so that a uniform clearance is obtained on all sides of the punch.



Rausch Rotary Filing Machine

The work-table can be set to any angle for obtaining the degree of clearance required for a die. The motor and work-table can also be reversed, so that the file extends upward through the table, thus giving the operator a clear vision of the line to which the work is to be filed. The height of the motor can be adjusted to suit the work. It operates at a speed of 1750 revolutions per minute. The table is 9 by 9 inches, and the distance from the column to the file is 5 1/8 inches.



Davenport Multiple-spindle Automatic Screw Machine with Box Base and Swinging Guards

MASTER SWITCH FOR CONTROLLING CRANES AND HOISTS

A master switch designed to obtain full speed control of cranes, hoists, steel mill machinery, etc., by regulating the circuits of a magnetic contactor

controller has recently been announced by the Electric Controller & Mfg. Co., 2700 E. 79th St., Cleveland, Ohio. Ball bearings and other refinements have been incorporated in the design to obtain smooth and easy operation. This switch is so designed that the contact fingers always ride on an uninterrupted plane surface.

The switch has a short-throw operating handle and an accurately machined and notched track for a roller-type centering

Master Switch for Controlling Cranes and Hoists

device which permits the operator to determine the various speed points by "feel." There are six points of speed control in either direction with an overload reset at the "off" position. A number of these switches can be grouped close together either in the upright or inverted position.

RIVETT SPEED-BOX DRIVE FOR BENCH LATHES

The elimination of overhead driving belts and countershafts is an important advantage of a speed-box motor drive for bench lathes recently developed by the Rivett Lathe & Grinder Corporation, Brighton District, Boston, Mass. This feature is obtained by attaching the speed-box to the under side of the bench directly below the lathe, as shown in Fig. 1. Any standard alternating- or direct-current motor of a size suitable for bench lathes can be mounted on the rear face of the speed-box as shown in Fig. 2.

The drive is by silent chain from the motor to the lower shaft of the speed-box. Two pairs of helical steel gears in the speed-box, which are always in mesh, transmit power to the cone driving pulley. A leather belt, passing through guarded slots in the bench, transmits power from the cone driving pulley to the lathe spindle. The speed-box gears are mounted on heat-treated and ground shafts which run in tapered roller bearings. The bearings and gears are splash lubricated.

A double-end, splash-lubricated friction clutch inside the gear-box serves to engage either the low- or high-speed gears. This clutch is operated through a rocking lever at the front of the gear-box. In the cabinet installation shown in Fig. 1, the rocking lever is actuated by two self-locking levers at the front of the cabinet. These levers provide for starting and stopping the lathe as well as for obtaining either the high or low speed. The belt is shifted on the cone pulleys by the conveniently located knob shown projecting from the left-hand end of the cabinet in Fig. 1.

With open bench installations, the starting and stopping of the lathe, on either the high or low speed, is accomplished by means

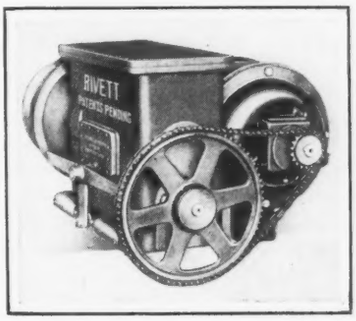


Fig. 2. Rivett Speed-box Drive with Chain Guard Removed

of two foot-treadles connected with the rocking lever which operates the friction clutch. Such installations leave both hands of the operator free to handle the work or manipulate the lathe. Pressure on one of the foot-treadles engages the high speed, while pressure on the other treadle engages the low speed. The drive is disengaged and the lathe stopped when the foot is removed from the treadle.

Six forward speeds are secured through the two-speed gear-box and the cone pulley drive. When desired, a reversing electric switch may be used for reversing the direction of spindle rotation. A push-button starter having three buttons, one for neutral and one each for forward and reverse rotation provides convenient control for the cabinet installation illustrated.

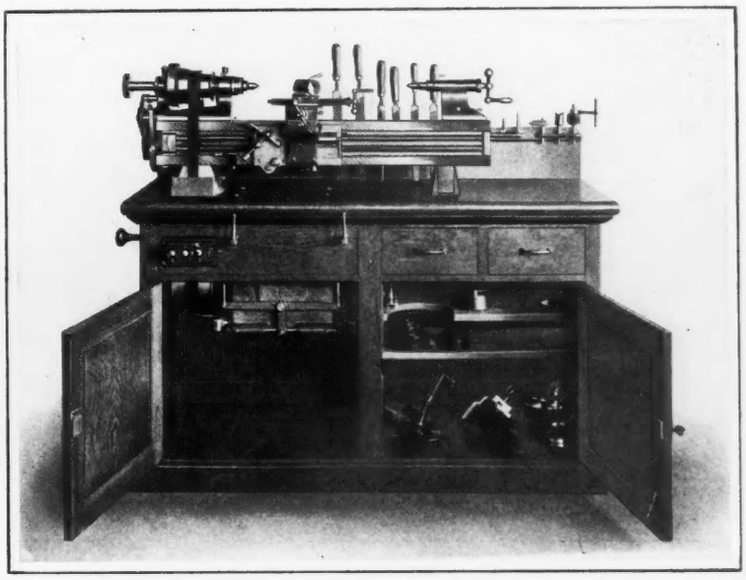


Fig. 1. Rivett Speed-box Drive Applied to Cabinet-mounted Bench Lathe

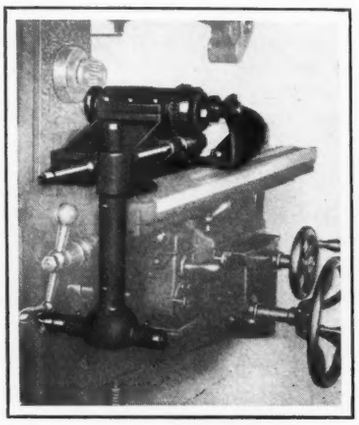
A motor-driven attachment has also been developed for performing grinding operations. This attachment, not shown in the illustration, is mounted on the compound slide rest of the lathe and requires no overhead belts. It is adjustable to any angle, both for external and internal grinding.

"LOMBARD" AUTOMATIC STARTING CLUTCH

The Washburn Shops of the Worcester Polytechnic Institute, Worcester, Mass., have developed a mechanical clutch or starter known as the "Lombard Automatic" for reducing the starting loads on a motor and absorbing shocks and vibrations encountered in power transmission. This starter is designed primarily to be attached directly to the shafts of motors, but may be applied to gear, chain, V-belt or flat belt drives. It is applicable to both driven and driving units. The drive will operate in either a horizontal or a vertical position or in either direction of rotation. Any amount of power can be transmitted with this design.

An expanding centrifugal accelerator, arranged as shown in the illustration, contains a fluid which automatically produces the necessary driving pressure. The pressure is applied in a radial direction for applications such as that shown in the illustration. In this case, the drive is connected directly to the shaft of an electric motor. For the smaller size drives, mercury is usually employed as the fluid, while water is used for the larger sizes. As the accelerator is permanently sealed, there is no chance for the fluid to leak out.

When the starter is at rest, the fluid is in the lower half of the accelerator. A short interval or period of time is required for the fluid to become distributed uniformly around the inside of the accelerator. Until this distribution takes place, there is no effective pressure. It is this condition that allows the motor to attain full speed at once and then gradually pick up the load. The gradual building up of the pressure exerted by the fluid produces a smooth pick-up for the driving shaft. The pick-up time may be fixed to suit conditions.



Frew Cam-cutting Attachment for Milling Machine

FREW CAM-CUTTING ATTACHMENT

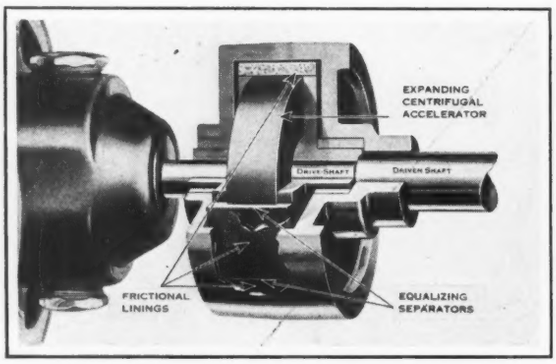
A cam-cutting attachment designed for application to standard milling machines is being placed on the market by the Frew Machine Co., 132 W. Venango St., Philadelphia, Pa. This attachment is intended for use in shops where there is not enough cam cutting done to warrant purchasing a cam milling machine. It is bolted to the table of the milling machine as illustrated, is power-driven, and is automatic in action. The operation is controlled by a master cam.

The spindle and driving gear are in one piece. The work is mounted on the forward end of the spindle and the master cam or former is doweled to the face of the worm-gear at the rear. The spindle slide is pressed against the former-pin roller by a weight. The former-pin bracket is adjustable and permits formers much larger than the work to be used.

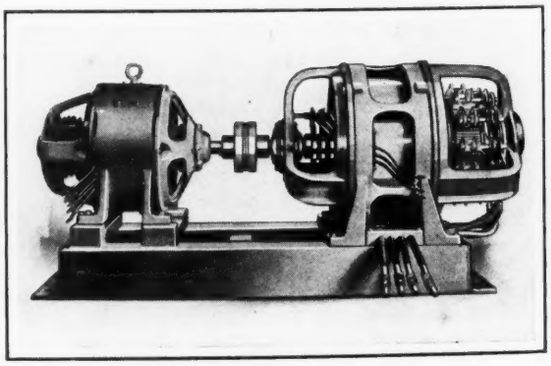
In operation, the spindle of the attachment is on a level with the cutter-spindle. As the former pin is not in a fixed relation to the cutter, the work can be fed up to the cutter by means of the milling-machine slide for taking roughing and finishing cuts, for regulating the size of the cam, etc. Cams up to 12 inches in diameter can be cut.

RELIANCE FREQUENCY CONVERTER

To provide an economical method of obtaining single-phase, two-phase, or three-phase current at frequencies as low as 3 to 15 cycles, the Reliance Electric & Engineering Co., 1042-1090 Ivanhoe Road, Cleveland, Ohio, has developed the special frequency converter shown in the accompanying illustration.



Starting Clutch Developed by the Washburn Shops of the Worcester Polytechnic Institute



Reliance Frequency Converter for Use in Varying the Speed of Induction Motors

This converter is built for operation on either two-phase or three-phase current. It may be employed for obtaining variations in the speed of squirrel-cage induction motors or speeds that are either higher or lower than those obtained from induction motors operating on currents of standard frequency.

PEDRICK TOOL-GRINDING GAGE

To facilitate the accurate grinding of such tools as are used in lathes, boring mills, and planers, the Pedrick Tool & Machine Co., 3639 N. Lawrence St., Philadelphia, Pa., has placed on the market the gage shown in the accompanying illustration. The first step in grinding a tool is to make sure that the base is straight and flat, as it is this surface that rests on the bottom of the slot in the toolpost or tool-block. Thus, the bottom face of the tool is tested for flatness on the base of the fixture *A*. This not only facilitates the use of the gage when the tool is being ground, but also eliminates rocking of the tool in the holder and danger of breakage when the clamping screws are tightened.

The cone-shaped post *C* of the gage is used to test the end and side clearance angles of the tool. The wing-shaped member *D* is a sliding fit over the post *B*, and is used to gage the top angle or the clearance of the surface *F*. The position of the member *D* can be changed to accommodate either right-hand or left-hand tools and to permit the gaging of the top angle of tools intended for cutting steel, brass, cast iron, or soft steel. In gaging the top angle, the bottom surface of the tool rests on the base *A* of the gage while the member *D* is slid down the post *B* until the proper edge is in contact with the tool.

Gerstner Tool Chest with Large Variety of Drawer Sizes

The recess on the side of the gage is provided for testing the form of the tool face. The two ends of this recess provide for gaging both right-hand and left-hand tools. An accurately formed V-slot in the opposite side of the base *A* provides for testing the shape of a threading tool.

GERSTNER TOOL CHEST

A tool chest designed for machinists, toolmakers, and other mechanics who require a large variety of drawer sizes, has been brought out by H. Gerstner & Sons, 276 Columbia St., Dayton, Ohio. As shown in the illustration, this chest has three full-length drawers, 18 1/4 inches long inside, and seven drawers 7 1/8 inches long inside. There is also a center drawer designed to receive MACHINERY'S HANDBOOK or a drill block and there is a roomy top compartment.

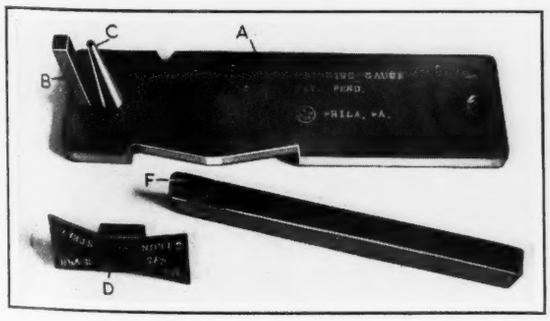
The front lid of this chest slides on steel bearings under the bottom drawer. It also swings upward and locks automatically when the top lid is down. The chest is finished either in an imitation seal grain leather or in a polished quartered oak. It has nickel fittings, a steel cored leather handle, and felt-lined drawer bottoms.

BROWN & SHARPE GAGES

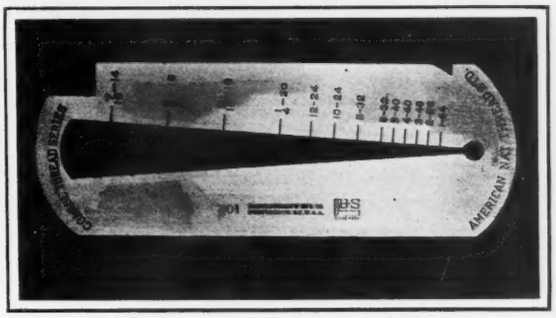
A handy gage for identifying different sizes of screw threads made in accordance with the American National (or U. S.) screw thread standards has recently been placed on the market by the Brown & Sharpe Mfg. Co., Providence, R. I. This gage, known as the No. 701, is in the form of a flat plate having a tapered slot, as shown in the illustration. One side of the gage is graduated for the fine thread series, and the other side for the coarse thread series.

A 3-inch scale with 1/8-inch graduations is provided on the outer edge for measuring the length of screws. Slots at each end of the scale permit the heads of both round- and flat-head screws to be set against a positive stop for measuring.

To facilitate the accurate checking of car wheel work to the standards of the American Railway Association, the Brown & Sharpe Mfg. Co. has also brought out two gages to supplement the wheel-defect, worn coupler limit and worn journal collar gage No. 728A of this company's manufacture. One of the new gages, the No. 728B maximum flange



Pedrick Gage for Testing Angles and Form of Tools to Insure Accurate Grinding



American National Standard Screw Gage Made by Brown & Sharpe Mfg. Co.

thickness gage, is intended for cast-iron wheels. This gage is made of tool steel and is accurately machined and hardened. The second gage, the No. 728C, is a standard mounting and check gage for cast-iron and cast-steel wheels. The gaging surfaces are of tool steel and are held in their correct positions by a tie-bar of T-section.

STANDARDIZED SPINDLE NOSE ON MONARCH LATHES

The lathes built by the Monarch Machine Tool Co., Sidney, Ohio, are now provided with the standard flanged spindle nose which has been proposed by the manufacturers of turning machines. The spindle of Monarch machines is an upset forging with the flange integral. The short tapered centralizing section and the flange, as well as the outside diameter, are ground, being located from the journal bearings of the spindle. The taper hole in the spindle is, of course, ground also. Chucks, plates, and fixtures machined to working gages made by the Pratt & Whitney Co. especially for checking such parts, will fit on the spindle nose with an allowance of 0.004 inch for a draw fit against the locating flange for properly centralizing.

Studs anchored in the body of the chucks, plates, and fixtures engage nuts on the back of the flange for holding the plates or chucks on the spindle nose. With this design, it is possible to remove a faceplate having work on it any number of times and replace it on the spindle nose without removing the work from the faceplate. The work will be properly centralized each time.

Two sizes of spindle noses cover the entire range of lathes made by the company. An 8 1/4-inch diameter flange is furnished on all machines from 14 to 20 inches swing, inclusive, and an 11-inch diameter flange for lathes above 20 inches swing and up to 36 inches swing.

AUBURN END-THRUST BALL BEARING

A thrust bearing that takes the end thrust of a rotating shaft directly from the end of the shaft instead of from a shoulder has recently been brought out by the Auburn Ball Bearing Co., 57-85 Clarissa St., Rochester, N. Y. The two races and the balls which constitute the complete bearing are held together as a unit by a rod through the center,

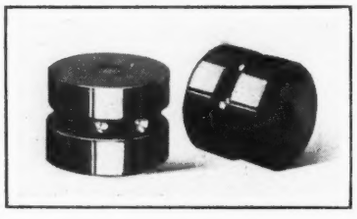
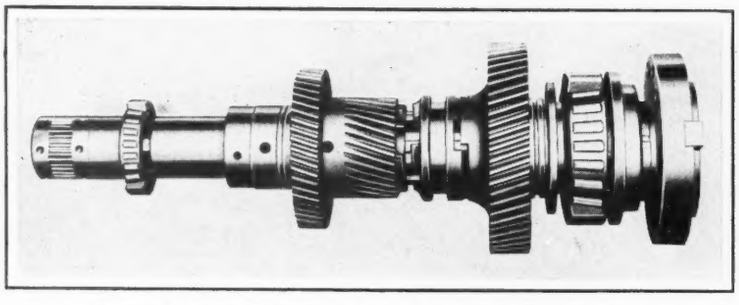


Fig. 1. Auburn End-thrust Ball Bearing

as shown in Figs. 1 and 2. This rod has sufficient clearance under the flanged head to permit the races to rotate freely. The complete bearing unit is designed to fit into a recess at the end of the shaft, as shown in Fig. 2. A simple installation of this kind can be made with little machine work, as the recess that receives the bearing is the same diameter as the shaft.

The small pitch diameter of the ball groove or race, together with the large size of the balls,



Monarch Lathe Spindle with Standardized Spindle Nose

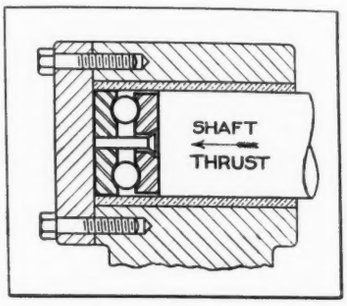


Fig. 2. Method of Applying Bearing Shown in Fig. 1

results in a relatively low peripheral speed for the balls. This feature adds to the capacity and life of the bearing. The bearing is available in sizes ranging from 1 3/16 inches to 3 15/16 inches in diameter. It is known as "T-114-RG."

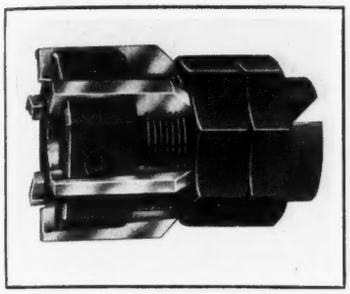
SAUTER SELF-WINDING TIME SWITCH

A single-throw, self-winding time switch for automatically starting and stopping blowers, pumps, ventilators, and other machinery connected with electrical circuits has been brought out by R. W. Cramer & Co., Inc., 136 Liberty St., New York City. This switch can be operated on a predetermined time basis. The main switch is motor-operated and is of the air-break, rotary, self-winding type. The motor operates on 115- and 230-volt direct current or alternating current of any frequency. The clock has a four-day mainspring, but is rewound automatically twice every twenty-four hours.

When used for constant schedule control, a plain dial is used, but for lighting circuits on an all-night or part-night schedule, the astronomic dial is recommended, as it automatically resets the control to suit the changes in local lighting or daylight time.

DAVIS EXPANSION REAMER

An expansion reamer with radially relieved interchangeable blades has been brought out recently by the Davis Boring Tool Co., 6200 Maple Ave., St. Louis, Mo. The body of the reamer is



Davis Expansion Reamer Made in Sizes Ranging from 1 1/2 to 6 Inches in Diameter

heat-treated carbon nickel steel, and the regular blades are made of high-speed steel. The blades are locked from the front end, the cutting thrust being taken against the back and bottom of the slot. This construction gives a full metal-to-metal bearing at the thrust points, which insures rigidity and eliminates the tendency to chatter. Shell type reamers are regularly made with a hole tapered 1/8 inch per foot, but they can also be supplied with straight holes if desired. Spiral-bladed reamers having either right- or left-hand spirals are made with a 10-degree spiral angle. The long travel of the adjusting nuts permits 50 per cent of the blade length to be ground away before the blades have to be replaced. The shell reamers are made in sizes ranging from 1 1/2 up to 6 inches in diameter. Only six sizes of blades are required to cover the entire range of bores.

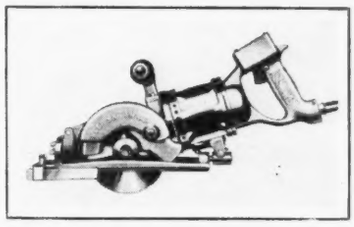
LINCOLN ELECTRODE FOR STAINLESS STEELS

An electrode known as "Stainweld A" is being introduced on the market by the Lincoln Electric Co., Cleveland, Ohio, for welding what are commonly known as the "18-8 stainless steels." The advantage claimed by the manufacturer is that by using this electrode, welds can be made that are of the same chemical content as the stainless steel itself, resulting in a dense ductile weld. This is accomplished by welding in a protected atmosphere which excludes oxygen and thus eliminates oxidation of the weld metal.

The electrode itself is of the same chemical composition as the metal, and is coated with a material which, in the intense heat of welding, forms a gaseous envelope around the arc. It is used with reversed polarity and permits the making of a weld that is as impervious to corrosion as the metal it joins. This new electrode is obtainable in 1/8-, 5/32-, and 3/16-inch sizes and in the regulation 14-inch lengths. It is applicable for either horizontal, vertical, or overhead welding.

VAN DORN PORTABLE ELECTRIC SAW

Three sizes of portable electric saws having saw blades 6, 8, and 10 inches in diameter, respectively, have been added to the line



Van Dorn Portable Electric Saw

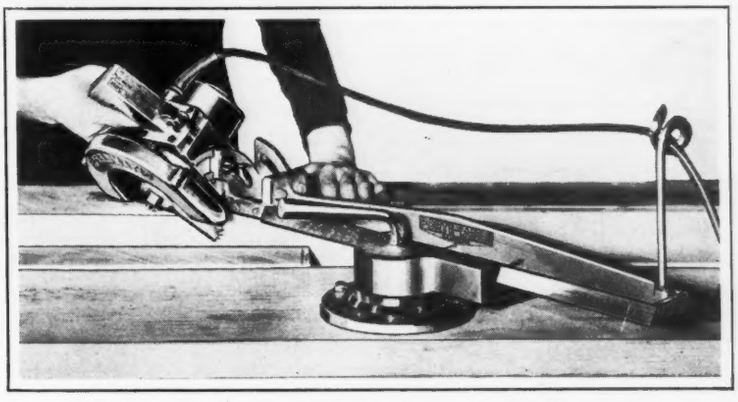
of tools made by the Van Dorn Electric Tool Co., Cleveland, Ohio. Circular saw blades may be employed for sawing all kinds of wood, while abrasive disks are used for cutting marble, asbestos, tile, porcelain, etc. The saws are driven by universal motors which operate on either alternating or direct current.

A safety switch starts the saw when the trigger is pulled and cuts off the current the instant the trigger is released. A telescopic guard opens as the saw enters the work and closes over the blade when the cut is finished. The depth and width of cut are regulated by a thumbscrew adjustment, and there is a graduated adjustment for bevel cuts. The maximum depth of cut for the three saw sizes is 1 3/4, 2 1/2, and 3 1/2 inches, respectively.

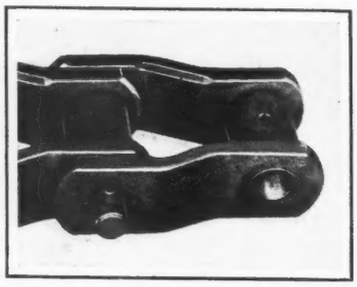
BENCH ATTACHMENT FOR PORTABLE SAW

An attachment has recently been brought out by the Porter Cable Machine Co., Salina and Wolf St., Syracuse, N. Y., which is designed to permit the use of the "Speedmatic" power saw as either a hand or a table type machine. The changes can be easily accomplished in less than a minute without having to use wrenches.

The swivel base on which the arm swings is graduated 60 degrees each side of zero, although the construction permits the arm to swing through a full circle or 360 degrees. The saw can be adjusted for taking compound-angle cuts by simply loosening a thumb-screw and tilting the blade to the desired angle. The blade may be tilted to any angle up to 45 degrees. The table attachment is made of cast iron and has dovetailed ways which are gibbed to provide adjustment for wear. The weight of the attachment, including the saw, is 52 pounds.



Porter-Cable "Speedmatic" Saw with Table Attachment



"Hyper" Alloy-steel Drive Chain

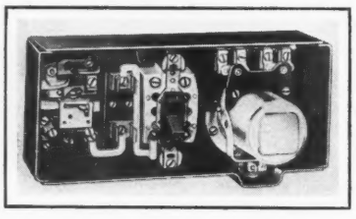
LINK-BELT "HYPER" DRIVING CHAIN

An alloy steel drive chain designed to meet the needs of heavy and positive power transmission has been brought out by the Link-Belt Co., 300 W. Pershing Road, Chicago, Ill. This "Hyper" chain is made with a new type of pin and cotter, the cotter being so designed that is cannot work loose when properly swelled after insertion. The pins, the bushings, and the holes in the side bars are all accurately ground. The manufacturing tolerance of 0.001 inch allowed on the chain parts insures accurate fits. The "Hyper" SS-40 chain has an ultimate strength of 75,000 pounds, while the ultimate strength of the SS-124 size "Hyper" chain is 150,000 pounds.

ALLEN-BRADLEY PRESSURE SWITCH

A pressure switch for starting and stopping compressor and pump motors has been placed on the market by the Allen-Bradley Co., 499 Clinton St., Milwaukee, Wis. This switch is designed along entirely new lines, and is extremely compact, being about the size of a small outlet box.

The switch is made in two sizes, the size B being made in four forms which include various combinations with or without overload breakers, disconnect switches, and fuse clips. This size unit is rated at 1 horsepower on a 110-220 volt direct-current circuit. For alternating-current circuits, the switch is rated as 1 horsepower on 110 volts and 2 horsepower on 220 volts. The size C switch is rated up to 5 horsepower. For larger ratings, the size B switch is used as a pilot control for magnetic starters of any desired rating.



Allen-Bradley Pressure Switch with Overload Breaker, Disconnect Switch, and Fuse Clip

ROBBINS & MYERS HOIST AND TROLLEY

For lifting and transporting light weight material rapidly and economically, the Hoist and Crane Division of Robbins & Myers, Inc., Springfield, Ohio, has brought out the Bantam hoist shown in Fig. 1. This hoist is 18 by 24 by 14 inches, weighs only 110 pounds, or 130 pounds with the trolley, and has a lifting capacity of 500 pounds. It is designed to operate at a speed of 30 feet per minute, and is equipped with a special motor. The hoist is made in styles suitable for alternating- and direct-current circuits with either a rope or push-button control. The frame is designed to permit operation on any standard I-beam or monorail trolley.

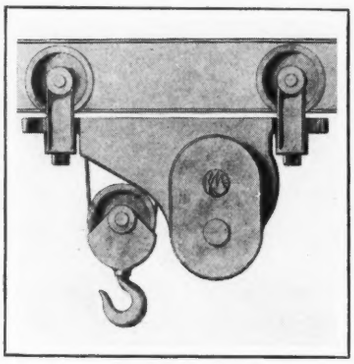


Fig. 1. Robbins & Myers Bantam Hoist

In addition to the hoist, this company has also announced the development of a line of I-beam trolleys known as the "Ace." These trolleys are made in plain types, as shown in Fig. 2, and also in geared types. The sizes range from 1/2 to 20 tons in capacity. The smaller sizes can be adjusted for operation on seven different sizes of I-beams. Heavy ribbed cast-steel frames and chilled and ground trolley wheels are used on this equipment. The metal of the wheels is of the same analysis as that used for chilled-iron railway car-wheels. A combination of eight Timken and four Hyatt roller bearings is employed to take care of all radial and thrust loads. The axle studs are drilled for Zerk Alemite lubrication.

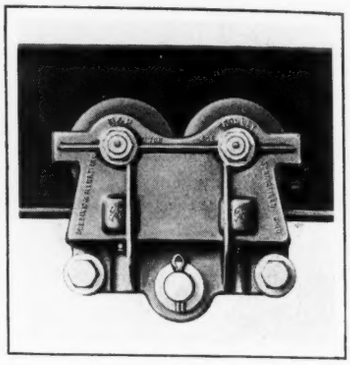
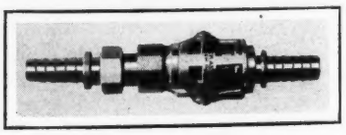


Fig. 2. Plain Type "Ace" I-beam Trolley

SHUT-OFF AIR VALVES AND COUPLINGS

In the "Quick-As-Wink" shut-off valves and couplings recently placed on the market by C. B. Hunt & Son, Salem, Ohio, a 1/4-inch push or pull on the outer member is the only movement required to turn the flow of air on or off. When one of these valves is used in combination with the couplings, air can be shut off anywhere on the hose line, and the air in the tool line is automatically "bled" to permit the removal of tools for repairs or oiling. It is claimed that in spite of the free swiveling action of the couplings and valves, they are air-tight under pressures up to 1000 pounds per square inch.

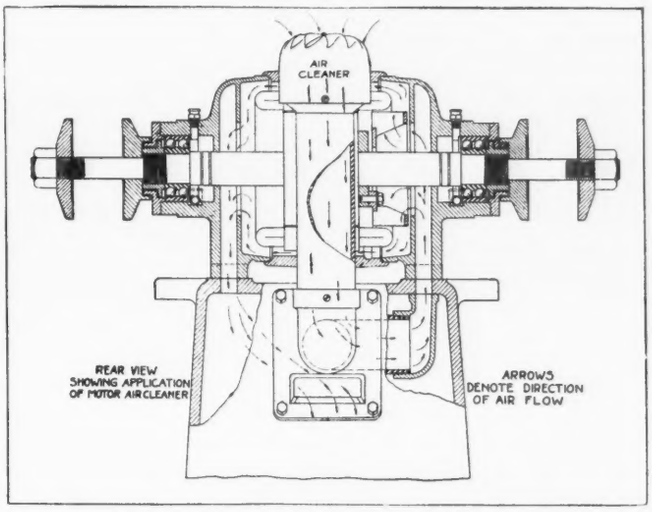


"Quick-As-Wink" Air Valve and Couplings

HAMMOND MOTOR AIR CLEANER

The motor air cleaner shown in the accompanying illustration is now being incorporated as standard equipment in all grinding and polishing machines of three horsepower and larger made by Hammond Machinery Builders, Inc., 1604 Douglas Ave., Kalamazoo, Mich. The motor is totally enclosed, but is cooled by a fan mounted on the spindle. All incoming air must pass through the centrifugal air cleaner which is connected through the pedestal to the end bell.

The fan on the spindle forces the clean cool air over the motor windings and through the opposite end bell and pedestal to the outlet. An efficient and cool operating unit with the temperature maintained at a point less than 40 degrees C. results from the use of the ventilating system described.



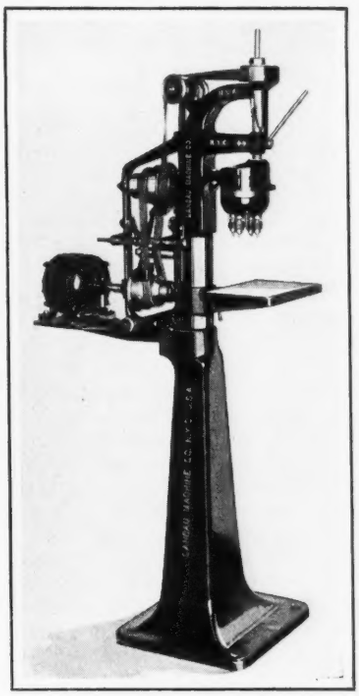
Motor Air Cleaner System Used on Hammond Grinding and Polishing Machines

COMBINATION BLOWER AND VACUUM CLEANER

Equipment that cleans either by suction or by blowing is now being placed on the market by the United States Electrical Tool Co., 2477 W. 6th St., Cincinnati, Ohio. This combination blower and vacuum cleaner picks up dust and other free dirt wherever the nozzle or brush can penetrate, and simply by removing the dust bag and changing the location of the hose, it blows dust from places hard to get at, such as the inside of motors, machines, and switchboards. The universal motor provided operates on alternating or direct current. Ease of handling is one of the features of the equipment, as the motor and fan can be conveniently hung over the user's shoulder, or suspended from a hook. The outfit is made in two sizes, one of which weighs 7 1/2 pounds, and the other 9 1/2 pounds.

LANDAU IMPROVED DRILLING AND TAPPING MACHINE

An improved combination drilling and tapping machine of the construction here illustrated is being placed on the market by the Landau Machine & Drill Press Co., 200 Broadway, New York City. The spindle attachment has two members, the upper of which is fastened to the drill stand. The lower member of the attachment can be indexed to bring any of the four spindles into the working position. Two of these spindles can be used for tapping and two for drilling, or three can be employed for drilling and one for tapping. Each spindle can be adjusted independently for depth of cut.



Landau Improved Drilling and Tapping Machine

Any of the spindles can be brought into service instantly. A centering device prevents operation of the feed lever until the drilling or tapping spindle is in alignment with the main drive spindle. This spindle is automatically released as each operation is completed. Successive operations can be performed without removing the work from the table. The machine can also be used as an ordinary drill press, in which case three spindles remain idle. Speeds can be changed quickly without stopping the machine. This equipment has a capacity for using taps up to 1/4 inch in size. It weighs about 300 pounds.

* * *

CORRECT USE OF WORD "CARBORUNDUM"

The Carborundum Co., Niagara Falls, N. Y., in its campaign against the growing tendency to treat the word "Carborundum" as a common noun, has announced that "Carborundum" is a trademark of this company, registered in the United States and many foreign countries, and is applied by it to its range of products—abrasives and refractories. The Carborundum Co. states that the proper general term is silicon carbide; this is the form that should be used in articles, etc., unless a specific product of the Carborundum Co. is referred to. The word "Carborundum" should be written with a capital letter and quotation marks.

PERSONALS

R. F. MARSHALL has been appointed advertising manager of Robbins & Myers Sales, Inc., Springfield, Ohio.

EARL E. HODIL has been appointed chief draftsman of the Thomas Spacing Machine Co., Pittsburgh, Pa., manufacturer of fabricating machinery.

HARRY E. DUNHAM, patent attorney with the General Electric Co., Schenectady, N. Y., since 1912, has been made assistant manager of the patent department.

S. H. PITTMAN has been appointed manager of the sales promotion section, domestic appliance department, of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Mr. Pittman's headquarters will be in Mansfield, Ohio.

LOUIS J. KANITZ has been made general sales manager of the Continental Motors Corporation, Detroit, Mich. Mr. Kanitz joined the corporation in 1920, and for the last three years he has been in charge of the industrial engine division.

B. VAN DYKE, of the Quincy, Ill., sales division of the Gardner-Denver Co., has been transferred to the New York office of the organization. HENDRICK STOLK, until recently with Stokvis & Zonen, of Holland, has been transferred to St. Louis from the Quincy plant, where he completed a sales study course.

O. H. ESCHHOLZ, manager of the patent department of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., and W. D. O'CONNOR, a member of the patent department, have been admitted to the Bar of Allegheny County, of the Supreme Court of Pennsylvania, and of the District Court of the United States, Western District of Pennsylvania.

E. E. SPENCER, president of the Stromberg Electric Co., Chicago, Ill., sailed for Europe on the *Berengaria* March 31 for an extended European tour. The Stromberg Electric Co. manufactures various types of time recording and control apparatus, and Mr. Spencer is planning to make arrangements for representatives in seven foreign countries, including England, France, Germany, Sweden, Italy, and Switzerland.

JORDAN KORP, metallurgical engineer with the Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa., sailed for Germany on March 29. Mr. Korp expects to make a three months' tour of European heat-treating plants, his primary purpose being to inspect the operation of Hump hardening and Homo tempering furnaces installed in leading plants in Great Britain, Norway and Sweden, and the Continent.

WALTER F. TANT, president of the Silent Automatic Corporation, Detroit, Mich., and one of the outstanding figures in the development of the oil burner industry, has been elected president of the American Oil Burner Association. The new president has taken an active interest in the affairs of the Association since April, 1926, when he was first elected to the board of directors. Mr. Tant has been president of the Silent Automatic Corporation for five years.

HOMER S. TRECARTIN, formerly general manager of the Roller Bearing Co. of America, has left this company to become connected with the Russian organization Sharikopodskipnekstroy, which is planning to build and equip a very large factory for the manufacture of ball and roller bearings in Moscow, Russia. Mr. Trecartin will direct the design of this new plant and its equipment and will organize it for production when it is ready for operation; this, according to present plans, should be by the end of the year. Mr. Trecartin, who received his education at the Pratt Institute and the Brooklyn Polytechnic Institute, has had a broad and varied mechanical experience, having been connected with the E. W. Bliss Co., Cortland Electric Co., General Electric Co., United Shoe Machinery Corporation, and the General Motors Corporation. He has also organized two companies of his own, the Tanner Engineering Co., to develop and manufacture electrical scientific specialties, and the Electrical Utility Corporation, to manufacture equipment under his own patents.

Homer S. Trecartin

WILFRED SYKES has been appointed assistant to the president of the Inland Steel Co., Chicago, Ill., succeeding the late David P. Thompson. Mr. Sykes has been assistant general superintendent of the company's Indiana Harbor Works since 1927. FREDERICK M. GILLIES will become assistant general superintendent in place of Mr. Sykes. JAMES H. WALSH, formerly general superintendent of the Indiana Harbor Works, has been promoted to the position of works manager. HENRY R. DEHOLL succeeds Mr. Walsh as general superintendent. Other new appointments at the company's Indiana Harbor Works include C. A. BRASSERT, superintendent of the 100-inch plate mill; H. W. JOHNSON, superintendent of blast furnaces; T. F. PLIMPTON, assistant superintendent of blast furnaces; T. J. GARDNER, superintendent of coke plants; and C. L. CORBAN, assistant superintendent of coke plants.

T. M. REESE has joined the staff of Manning, Maxwell & Moore, Inc., 100 E. 42nd St., New York City, and has been made manager of the Pittsburgh district in charge of sales of Putnam machine tools and Shaw electric cranes. Mr. Reese will assist the Pittsburgh representative, Arch Machinery Co., and will direct the salesmen assigned to that territory. For ten years he was associated with the Motch & Merryweather Machinery Co. Just previous to his present appointment he was vice-president of the Arch Machinery Co.

WILLIAM W. MACON has been appointed editor-in-chief of the *Iron Age*, succeeding ALVIN I. FINDLEY, who has held that position during most of the twenty-five years that he has been associated with the publication. Mr. Findley will continue to serve as editor emeritus. Mr. Macon has been connected with the editorial staff of the *Iron Age* for nineteen years and has been managing editor for the last twelve years. GILBERT L. LACHER and CLARENCE E. WRIGHT, associate editors for the last four years, have been appointed managing editor and news editor, respectively.

NEWS OF THE INDUSTRY

HENRY PRENTISS & CO., INC., announces that its New York office is now located at 405 Lexington Ave.

TEXAS CO., manufacturer of petroleum products, has removed its New York offices to 135 E. 42nd St.

SANDVIK CONVEYOR MFG CO., 21-23 Amsterdam St., Newark, N. J., announces the opening of a Chicago office at 180 N. Michigan Ave., with Morton Fries in charge.

CHAIN BELT CO., Milwaukee, Wis., has appointed the Corbin Supply Co. of Macon, Ga., representative for the complete line of chain and transmission equipment made by this company.

FOOTE BROS. GEAR & MACHINE CO., 111 N. Canal St., Chicago, Ill., has appointed Sutor & Co., 2008 E. Slauson Ave., Los Angeles, Cal., representative for the IXL line of speed reducers and gear products.

AMERICAN AIR FILTER CO., INC., First and Central Ave., Louisville, Ky., has been formed through the consolidation of the REED AIR FILTER CO., the MIDWEST MFG. CO., and the NATIONAL AIR FILTER CO.

WORCESTER STEEL STAMP CO., 44 Portland St., Worcester, Mass., which has heretofore been carried on as a partnership, has been incorporated as the WORCESTER STAMP CO. The personnel will remain the same.

ELECTRIC MACHINERY MFG. CO., Minneapolis, Minn., has moved its Chicago office to 20 N. Wacker Drive Building, Room 1567. The Baltimore office of the company has been moved from 432 N. Calvert St. to 600 N. Calvert St.

THOMAS SPACING MACHINE CO., Pittsburgh, Pa., manufacturer of fabricating machinery, announces the removal of

its Chicago sales office from the Midland Building to 208 S. La Salle St., Room 927. E. C. Thomas is in charge of this office.

MASON REGULATOR CO., Dorchester Center, Boston, Mass., manufacturer of pressure control apparatus, has appointed King & Shepherd, 50 Church St., New York City, distributors of the company's products for the Manhattan district.

ROLLER-SMITH CO., 233 Broadway, New York City, manufacturer of electrical instruments, has appointed the Henry N. Muller Co., First National Bank Building, Pittsburgh, Pa., district sales agent of the company in western Pennsylvania, eastern Ohio, and West Virginia.

UNION TWIST DRILL CO., Athol, Mass., has appointed the Smith Booth Usher Co., Los Angeles, Cal., distributor of its line of twist drills, cutters, hobs, reamers, etc. The same company has been appointed distributor for the line of taps, dies, and screw plates made by the S. W. Card Mfg. Co.

LINCOLN ELECTRIC CO., Coit Road and Kirby Ave., Cleveland, Ohio, manufacturer of Stable-Arc welders and Linc-Weld motors, has opened new offices at 338 Barnard St., Saginaw, Mich., with J. E. Luter in charge; at 225 E. Columbia St., Fort Wayne, Ind., with D. H. Carver in charge; and at Oil City, Pa., with E. D. Anderson in charge.

CHICAGO PNEUMATIC TOOL CO., 6 E. 44th St., New York City, has opened a branch office at 327 Philcade Building, Tulsa, Okla. George J. Lynch has been appointed district manager in charge of this office. The company recently opened an office and service station at 1 W. 16th St., Oklahoma City, Okla., to handle the CP Tucone rock bit, and that office will continue in the same capacity.

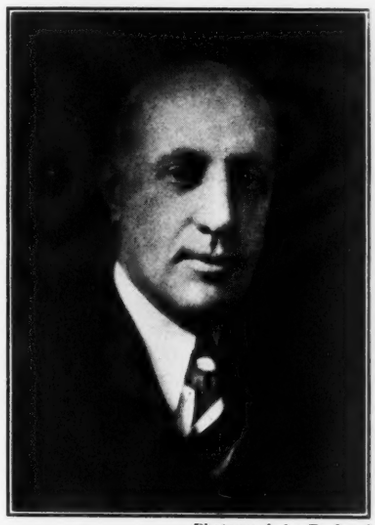
MICHIGAN TOOL CO., Detroit, Mich., has just completed a new factory and office building which will give the company the necessary room for expansion and bring all the machinery and equipment on one floor. The new building contains 60,000 square feet of floor space. The first floor is devoted to machinery and equipment, and the second floor to the general offices and engineering departments.

RACINE TOOL & MACHINE CO., 1752 State St., Racine, Wis., manufacturer of Racine shear-cut production saws and a complete line of other power metal-cutting saws, has recently moved into a new and larger factory building. The new factory affords about three times the floor space available in the former plant. The larger quarters have been found necessary because of the constantly increasing demand for the products of the company.

MODERN TOOL WORKS DIVISION of the CONSOLIDATED MACHINE TOOL CORPORATION OF AMERICA, Rochester, N. Y., has appointed the William G. Harvey Co., 540 First Trust and Deposit Bldg., Syracuse, N. Y., and 307 Crosby Bldg., Buffalo, N. Y., sales representative for the complete line of tools made by this concern, including Magic chucks and collets, stud setters, milling cutters, threading machines, and stationary and rotary type die-heads and chasers.

CHICAGO PNEUMATIC TOOL CO., 6 E. 44th St., New York City, announces the opening of the following new branch offices: Oklahoma City, Okla., Perrine Bldg.; Tulsa, Okla., 327 Philcade Bldg.; Houston, Tex., Merchants & Manufacturers Bldg. Service stations and warehouses have been established at both Oklahoma City and Houston, where air and gas compressors, engines, pneumatic and electric tools, rock drills, etc., will be carried, as well as parts for servicing.

BELLIS HEAT TREATING CO., Branford, Conn., manufacturer of electric furnaces and heat-treating equipment, has opened



Photograph by Bachrach

Louis W. Sumner

an office in Detroit, Mich., in the Bank of Michigan Building at 12244 Dexter Blvd., with Louis W. Sumner in charge. The territory covered by the new offices will comprise the state of Michigan and Western Ontario. A complete stock of Lavite and replacement pots, as well as electrodes, will be carried at these offices, and a Bellis triple-unit high-speed electric furnace and auxiliary equipment will be installed there as a permanent exhibit.

EX-CELL-O AIRCRAFT & TOOL CORPORATION, Detroit, Mich., is completing its sixth major plant expansion in two years. The addition has been found necessary because of a contract recently placed with this company by the Soviet Government of Russia for automobile truck parts and tools. The Austin Co. of Cleveland, Ohio, has charge of the construction of the new plant addition. The new building will be 55 by 260 feet, of one-story steel frame construction.

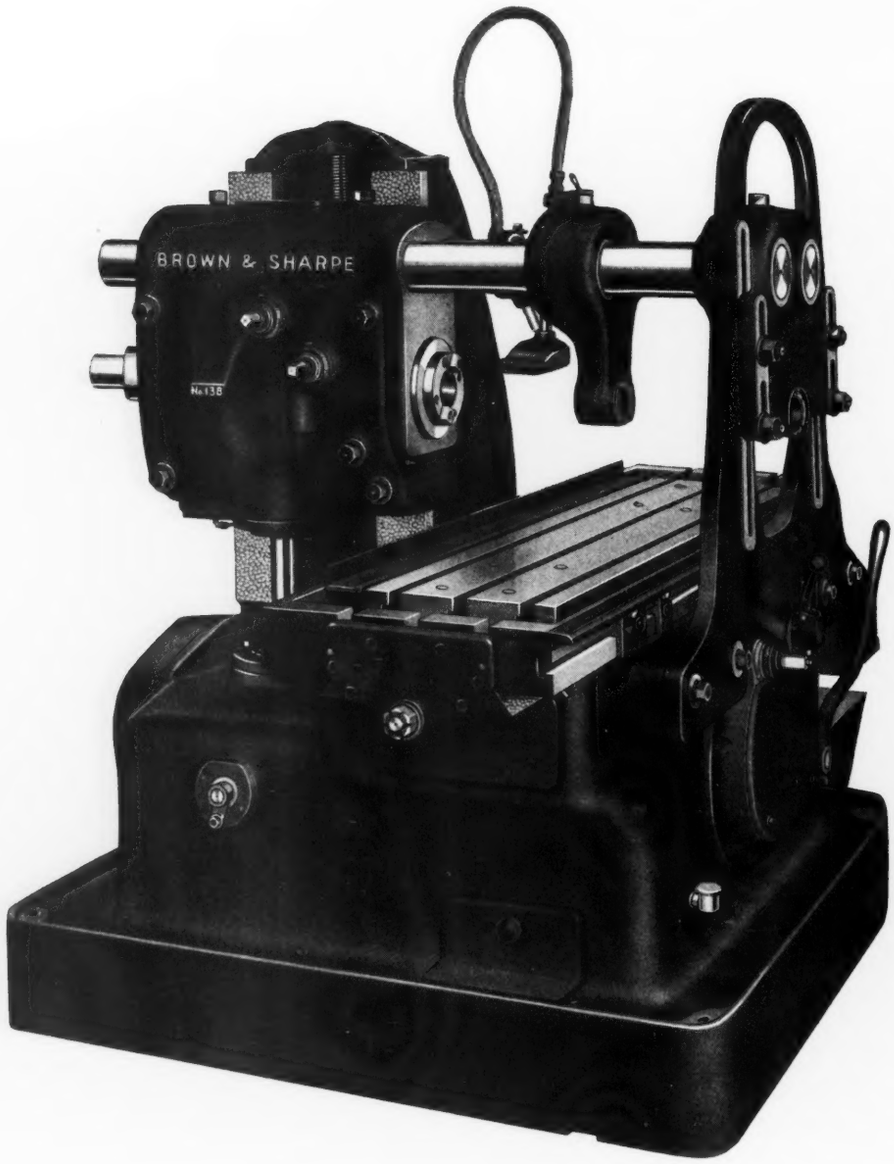
GREEN BAY BARKER MACHINE & TOOL WORKS, Green Bay, Wis., and its subsidiary, the CANADIAN BARKER CO., Sault Ste. Marie, Ont., Canada, have taken over the complete line of drilling machines formerly manufactured by the Rockford Machine Tool Co., Rockford, Ill. This line will be redesigned and improved, and will be supplemented by a new line of all-geared vertical drilling machines and a new design of electro-hydraulic vertical and horizontal drilling machines, as well as special assembled drilling heads.

NATIONAL BRONZE & ALUMINUM FOUNDRY CO., Cleveland, Ohio, announces that the company has added a new furnace for the production of "Tenual" aluminum by the company's patented process. This furnace is the largest single unit ever built for the production of aluminum, having a daily capacity of 75 tons. The furnace itself weighs over 175 tons. It is operated entirely mechanically, raw material being charged at one end and the finished product delivered at the other. The company is in a position to furnish "Tenual" ingot aluminum to a few large consumers.

YOUNG RADIATOR CO., Racine, Wis., manufacturer of engine cooling radiators for trucks, tractors, and industrial machinery, and oil coolers for marine engines, as well as heating units for factories and industrial uses, report that arrangements have been made to purchase additional equipment for the company's stamping department, in order to meet the growing demands for the company's products. In spite of the recession in industry at large, the company has made very satisfactory gains in business during the first quarter of 1930 as compared with the same period in 1929.

BALDWIN-DUCKWORTH CHAIN CORPORATION, Springfield, Mass., has been formed through the merger of the BALDWIN CHAIN & MFG. CO. of Worcester and the DUCKWORTH CHAIN & MFG. CO. of Springfield. The new corporation will operate the present factories in Worcester and Springfield as separate divisions, with administrative headquarters in Springfield. The officers are: George H. Empsall, president; Frank J. Weschler, William E. Gilbert, and W. F. Cole, vice-presidents; and Frank J. Weschler, treasurer. George D. Gilbert has been appointed sales manager of the Duckworth Division, and Arthur W. Warren, sales manager of the Baldwin Division.

GARRISON GEAR GRINDER CO. and the GARRISON MACHINE WORKS, Dayton, Ohio, manufacturers of machinery for generating and grinding teeth of hardened gears and of gear chucks, will continue to be operated by the estate of Orlando Garrison, who passed away March 28, and will be under the direct management of his two sons J. R. and R. P. Garrison, both of whom have been associated with the two organizations for a number of years. J. R. Garrison has devoted himself to the designing and engineering phases of the business for many years, and for the last twelve years has supervised the manufacture of the company's products. R. P. Garrison has devoted himself to marketing and sales, having a broad experience in this line, gained both in this country and abroad.



The New

Brown & Sharpe

No. 13B Plain Milling Machine

Improved Production Features

Base, Table Ways and Column are cast in one piece.

Massive Table with wide bearing surfaces assures rigidity and stability.

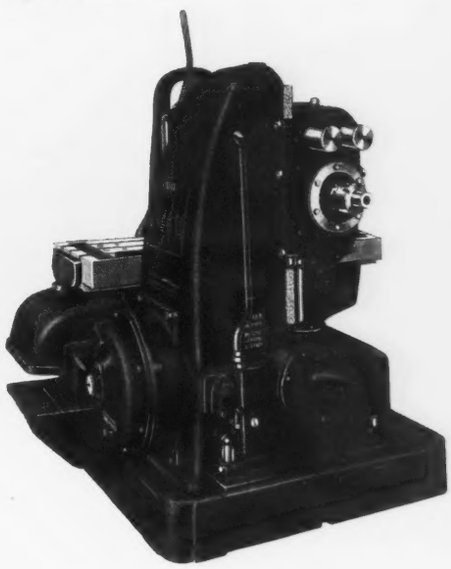
All power movements of table can be controlled by means of Adjustable Dogs. A wide variety of operating cycles can be obtained. Directional Hand Control of Table by Single Lever.

Multiple Dry-Disk Clutch provided with automatic compensation for wear.

Anti-Friction Bearings throughout assure largest possible percentage of the power entering the machine available at the cutting point.

Arbor Yokes, Cutters and Arbor can be removed without disturbing the outer brace.

Automatic Lubrication provided for Spindle Head, Speed and Feed Assemblies and Main Driving Mechanism. Single station provided for lubricating table bearings.



The New No. 13B Plain Milling Machine is exceptionally compact and rigid, with powerful cutting qualities and greatly simplified control.

Power enters the machine through the multiple dry-disk clutch and is delivered to the cutters, with small loss, through short, rugged splined shafts mounted on anti-friction bearings and heat-treated steel gears. Operation of the machine is simple—two levers controlling all functions.

Detailed specifications on this machine will be sent upon your request.

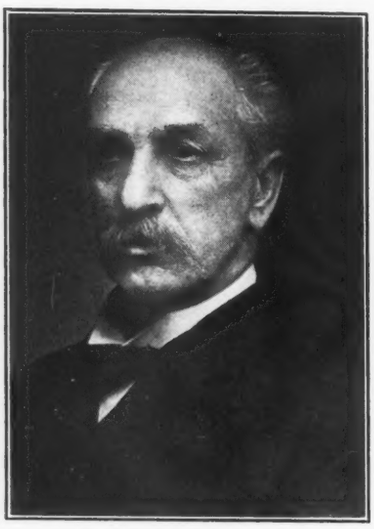
BROWN & SHARPE

BROWN & SHARPE MFG. CO. PROVIDENCE, R. I., U. S. A.

OBITUARIES

ELWIN R. HYDE

Elwin R. Hyde, president of the Bridgeport Safety Emery Wheel Co., Bridgeport, Conn., died March 25 at the age of seventy-nine. Mr. Hyde was born at West Chesterfield, Mass., in 1851. Through his own efforts he finished his education at the Wesleyan Academy, Wilbraham, Mass. His first contact with



Elwin R. Hyde

the abrasive industry was in 1876, when he had charge of the exhibit of the Northampton Emery Wheel Co. at the Centennial Exhibition in Philadelphia. Later he became a salesman for the Union Stone Co., Boston, Mass., makers of machinery and grinding wheels, and in 1880 he formed the Springfield Glue & Emery Co. to manufacture wheels and grinding and polishing machinery.

Mr. Hyde invented and developed the first automatic knife grinder, and in 1883 he designed a wet tool grinder which largely supplanted the grindstone for the sharpening of tools. In 1890 the company moved to Bridgeport, Conn., and in 1893 Mr. Hyde formed, with his brother, C. L. Hyde, and D. T. Homan, the Bridgeport Safety Emery Wheel Co.

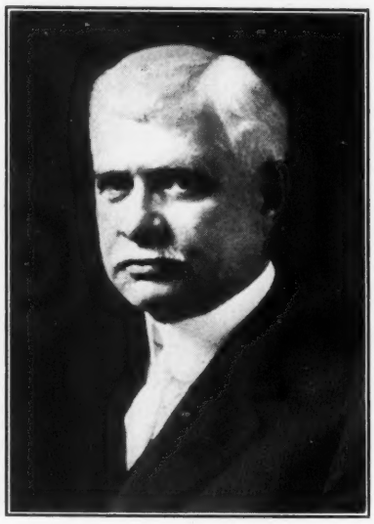
Mr. Hyde was one of the first to apply the direct-connected motor drive to grinding machines. One of the large electrical companies refused to furnish motors with shafts that Mr. Hyde considered of sufficient size to carry wheels on both ends of the shaft, so that he had to design his own motor. He was also one of the first to apply ball bearings to grinders. The sectional grinding wheel was first developed and patented by him.

Mr. Hyde's interest in grinding equipment continued up to the time of his death. He saw his plant grow from a small beginning to the present modern factory at Stratford, a suburb of Bridgeport, which now includes in its line of manufacture, besides grinding wheels and polishing machinery, floor grinders, tool grinders, shear blade grinders, face grinders, and swing frame grinders.

A. H. BULLARD

Augustus Hall Bullard, secretary and treasurer of the Bullard Company, of Bridgeport, Conn., died on April 5, following a short illness. Mr. Bullard was born in Hartford, Conn., March 9, 1867, educated in the public schools of that city, and upon graduating in 1885, became connected with the Hartford Equitable Indemnity Co. In July, 1886, he went to Bridgeport to assist his uncle, E. P. Bullard, who at that time owned the Bridgeport Machine Tool Works. In 1894 that company was incorporated as the Bullard Machine Tool Co., and A. H. Bullard was elected secretary and treasurer as well as a director.

Mr. Bullard gave liberally of his time to many institutions and lines of industry other than those with which he was connected in a business way. He was one of the founders of the Bridgeport Manufacturers' Association, of which he was corresponding secretary, and also assisted in forming the Connecticut Manufacturers' Association, serving for two years as president of that Association. He was active in the work of the National Metal Trades Association, the National Manufacturers' Association and the National Industrial Conference Board, and was a director in several banks. During the war, the Bullard Engineering Works was organized to build field artillery guns for the United States Government, and Mr. Bullard was



A. H. Bullard

made secretary and treasurer as well as a director of that company.

Mr. Bullard was widely known and highly regarded throughout his native state.

ORLANDO GARRISON

Orlando Garrison, president of the Garrison Gear Grinder Co. and the Garrison Machine Works, Dayton, Ohio, manufacturers of machinery for generating and grinding the teeth of hardened gears and of gear chucks, died suddenly from heart trouble March 28. Mr. Garrison was born in Gordon, Ohio, in 1875. He attended the public schools of Gordon and later graduated from the Lebanon University. After a broad experience, obtained with manufacturing concerns both in the Middle West and in the East, he founded the Garrison Machine Works in 1905, specializing in the design, development, and manufacture of automatic and special machinery. In 1917 he engaged in the manufacture of gear chucks under his own patents, and soon devoted himself to this line of equipment to the exclusion of all other products. He was also the inventor of many special ma-

Orlando Garrison

chines and of a generating gear tooth grinder, on the basis of which invention he organized the Garrison Gear Grinder Co. early in 1921.

ALFRED BROTHERHOOD

Alfred Brotherhood, the father of Percy M. Brotherhood, and the first of three generations to be identified with the machine tool industry, died suddenly at his home in East Aurora, N. Y., on April 1, aged eighty-three years.

He was born in Chippenham, England, in 1846 and trained in his father's shop there. He came to this country in 1867 and later moved to New York City where he established the machine tool department for the firm of Cook & Beggs, located on Cortlandt St.

Later Mr. Brotherhood became associated with Manning, Maxwell & Moore at 111 Liberty St., and established their machine tool department, taking up the development of the Shaw electric crane. In 1890 Mr. Brotherhood retired from Manning, Maxwell & Moore's business and moved to East Aurora, N. Y., where he was interested in a number of business enterprises. Mr. Brotherhood was one of the oldest members of the Engineers Club of New York City.

EUGENE MAXWELL MOORE, vice-president and director of Manning, Maxwell & Moore, Inc., died in New York March 27, after a brief illness. Mr. Moore, who was only thirty-nine years old, was a son of Charles A. Moore, one of the founders of Manning, Maxwell & Moore, Inc.

Write for
Bulletin 4081

Permanent Precision—

1. Square locked narrow guides.
2. Forged Steel Taper Gibs.
3. Feeding screws placed in center of narrow guides.
4. Guides and screws placed as close to cutting tool as is mechanically possible.
5. No keyways cut in feeding screws to destroy their accuracy.
6. Feeding nuts can always be centralized with feeding screws when adjustments are made.
7. Feeding screw and guide for table saddle placed in center of bed.
8. Ball bearings used liberally on all hand adjustments to eliminate friction, thereby permitting accurate setting of all units.

Not only is this paramount quality *built into* Ohio Horizontals, but provision is made for retaining it to the finest degree throughout the life of the machine.

Eight of the features that assure permanent accuracy in Ohio Horizontal Boring, Drilling and Milling Machines are listed at the left. How these features affect the production of fine work and also other exclusive features of these machines are explained, in a semi-technical manner easily understood, in our new Bulletin 4081. Let us send you a copy.

Ohio Horizontal Boring, Drilling and Milling Machines are built in all standard types and sizes:—the table type—planer table type—floor type—and combination floor and table type machines; meeting all requirements for high grade machine tools of this kind.

THE OHIO MACHINE TOOL COMPANY, KENTON, OHIO

General Distributors

JOSEPH T. RYERSON & SON, INC.

Chicago, Jersey City, Boston, Buffalo, Philadelphia, Cleveland, Detroit, Cincinnati, Milwaukee, Minneapolis, St. Louis, Tulsa, Kansas City, Denver. *Representation in:* New York, Pittsburgh, Grand Rapids, Houston, Los Angeles, Syracuse, Richmond, Duluth, Dallas, San Francisco.

COMING EVENTS

MAY 8—Metropolitan aeronautic meeting of the Society of Automotive Engineers in New York City. Coker F. Clarkson, secretary, 29 W. 39th St., New York City.

MAY 12-16—Convention and exhibition of the American Foundrymen's Association to be held in the Public Auditorium, Cleveland, Ohio. C. E. Hoyt, manager of exhibits, 222 W. Adams St., Chicago, Ill.

MAY 14—Meeting of the Steel Founders' Society of America at the Hotel Hollenden, Cleveland, O. Managing director, G. P. Rogers, 932 Graybar Bldg., New York City.

MAY 19-21—Fifth National Aeronautic Meeting, sponsored by the American Society of Mechanical Engineers, to be held at Dayton, Ohio. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

MAY 21-23—National Foreign Trade Convention at Los Angeles, Cal. Secretary, O. K. Davis, National Foreign Trade Council, India House, New York City.

MAY 25-29—Summer meeting of the Society of Automotive Engineers at French Lick Springs, Ind. Coker F. Clarkson, secretary, 29 W. 39th St., New York City.

JUNE 6-7—Annual convention of the National Association of Foremen to be held in the Civic Auditorium and the Chamber of Commerce Building, Toledo, Ohio. Henry J. Baumker, convention secretary, 316 Tenth St., Toledo, Ohio.

JUNE 9-12—Semi-annual meeting of the American Society of Mechanical Engineers at Hotel Book-Cadillac, Detroit, Mich. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

JUNE 12-14—Third national meeting of the Oil and Gas Power Division of the American Society of Mechanical Engineers to be held at Pennsylvania State College, State College, Pa. Calvin W. Rice, secretary, 29 W. 39th St., New York City.

JUNE 16-25—Second World Power Conference to be held in Berlin, Germany. For further information, address Calvin W. Rice, secretary, American Society of Mechanical Engineers, 29 W. 39th St., New York City, or Weltkraft, Ingenieurhaus, Berlin NW7, Germany.

JUNE 18-25—Annual meeting of the Mechanical Division, American Railway Association, in the new auditorium at Atlantic City, N. J. V. R. Hawthorne, secretary, 431 S. Dearborn St., Chicago, Ill.

JUNE 18-25—Exposition of railway supplies and equipment to be held under the auspices of the Railway Supply Manufacturers' Association at Atlantic City, N. J. J. D. Conway, secretary-treasurer, 1841 Oliver Building, Pittsburgh, Pa.

JUNE 23-27—Annual meeting of the American Society for Testing Materials at Haddon Hall, Atlantic City, N. J. C. L. Warwick, secretary-treasurer, Engineers' Club Building, 1315 Spruce St., Philadelphia, Pa.

JUNE 26-27—Semi-annual convention of the Steel Founders' Society of America at White Sulphur Springs, W. Va. Headquarters, Greenbrier Hotel. Managing director, G. P. Rogers, 932 Graybar Bldg., New York City.

AUGUST 24-29—Third International Congress of Applied Mechanics to be held at the Royal Technical Institute, Stockholm, Sweden. Further information may be obtained by addressing the American Society of Mechanical Engineers, 29 W. 39th St., New York City.

SEPTEMBER 22-26—Annual convention of the American Society for Steel Treating at the Stevens Hotel, Chicago, Ill. W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland, Ohio.

SEPTEMBER 22-26—Twelfth Annual National Metal Exposition under the auspices of the American Society for Steel Treating at the Stevens Hotel, Chicago, Ill. W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland, Ohio.

SEPTEMBER 22-26—National Metal Congress at the Stevens Hotel, Chicago, Ill., in conjunction with the annual convention of the American Society for Steel Treating and the annual fall meetings of the Metals Division and the Iron and Steel Division of the American Institute of Mining and Metallurgical Engineers; the Iron and Steel Division and the Machine Shop Practice Division of the American Society of Mechanical Engineers; and the American Welding Society.

NEW BOOKS AND PUBLICATIONS

DIAMOND CORE DRILL FITTINGS. 16 pages, 6 by 9 inches. Published by the United States Department of Commerce, Washington, D. C., as Commercial Standard CS17-30 of the Bureau of Standards.

ARITHMETIC OF ELECTRICITY. By T. O'Conor Sloane. 230 pages, 5 by 7 inches. Published by the Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $1.50.

This is the twenty-third edition of a treatise on electrical calculations of all kinds, reduced to a series of rules in the simplest forms involving only ordinary arithmetic. Each rule is illustrated by one or more practical problems with a detailed solution. The book covers direct and alternating current, Ohm's Law, electric dynamos and motors, electric railways, networks, etc.

THE WELDING ENCYCLOPEDIA. Compiled and edited by L. B. Mackenzie and H. S. Card. 542 pages, 6 by 9 inches; 670 illustrations. Published by the Welding Engineer Publishing Co., 608 S. Dearborn St., Chicago, Ill. Price, $5.

This is the seventh edition of a reference book and encyclopedia on autogenous welding. It contains 200 pages of definitions and discussions of words and terms used in welding literature. This is followed by treatises on gas, arc, resistance, and thermit welding, including instructions for welding all the commercial metals. In the new edition, extensive additions have been made to include up-to-date information on some of the newer applications of welding, such as aircraft welding, welding of machine parts, and structural steel welding. Other important additions cover the welding of special alloy steels and the welding of non-ferrous metals and their alloys.

STANDARD COSTS. By G. Charter Harrison. 308 pages, 6 by 8 1/2 inches. Published by the Ronald Press Co., 15 E. 26th St., New York City. Price $5.

The author of this book has played an important part in the development of modern management methods as applied to cost accounting. His book should be of considerable value to manufacturers who are searching for ways to maintain and increase profits. It outlines the practical procedure to be followed in setting standard costs in factory, shop, and sales office; designing, installing, and operating standard cost systems; checking actual against standard costs; getting at causes of cost and profit variations; and reporting results of the application of standard costs. The work covers the entire problem from estimating costs in advance through determining budgets and measuring the results of operations. In other words, it offers a practical basis for estimating the cost of any item or product in advance and controlling such costs during the operations involved. A number of charts and forms for recording the necessary data are given.

NEW CATALOGUES AND CIRCULARS

LIGHTING EQUIPMENT. Crouse-Hinds Co., Syracuse, N. Y. Catalogue 312, containing data on floodlights and industrial lighting units.

GAGES. Coats Machine Tool Co., Inc., 110 W. 40th St., New York City. Circular containing data on Krupp Mikrotast indicators and saddle gages.

BALL-BEARING PULLEYS. T. B. Wood's Sons Co., Chambersburg, Pa. Bulletin 272, containing list prices for the line of ball-bearing loose pulleys made by this concern.

SILENT GEARS. General Electric Co., Schenectady, N. Y. Bulletins GEA-1236 and 1242, treating of the construction and uses of Fabroil and Textolite gears, respectively.

TURRET LATHES. Warner & Swasey Co., Cleveland, Ohio. Bulletin entitled "Net Profits," containing examples of actual savings effected on jobs handled on Warner & Swasey turret lathes.

INDUSTRIAL SERVICE. Campbell, Peterson & Co., Inc., New York City. Catalogue outlining the industrial service offered by this concern in financing and developing new industries.

HOISTS. American Machinery Co., 2476 Aramingo Ave., Philadelphia, Pa. Post card advertising the Lo-Hed hoist, which has a capacity for lifting and carrying loads up to 24,000 pounds.

POWER PLANT INSTRUMENTS AND CONTROLLERS. Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa. Bulletin 660, treating of metered combustion control for boiler furnaces.

BENCH LATHES. General Radial Drill Co., Cincinnati, Ohio. Bulletin illustrating and describing the Schaffner 9-inch screw-cutting precision bench lathe. Various applications of this lathe are illustrated.

MOTORS. Master Electric Co., 100 Davis Ave., Dayton, Ohio. Bulletin entitled, "Settings of the Power Diamond," showing a wide variety of applications of Master motors, which range from 1/20 to 10 horsepower.

MOTORS. Reliance Electric & Engineering Co., Ivanhoe Road, Cleveland, Ohio. Bulletin descriptive of Reliance Type AA induction motors equipped with ball bearings, for two- and three-phase alternating-current circuits.

FOUNDRY EQUIPMENT. Link-Belt Co., 300 W. Pershing Road, Chicago, Ill. Catalogue 1090, illustrating and describing recent installations of Link-Belt foundry equipment for the preparation and handling of sand, molds, and castings.

TOOLS. L. S. Starrett Co., Athol, Mass. Fiftieth Anniversary catalogue No. 25, illustrating and describing the full line of Starrett tools, including steel tapes, hacksaws, hacksaw frames, rules, squares, protractors, depth gages, micrometers, etc.

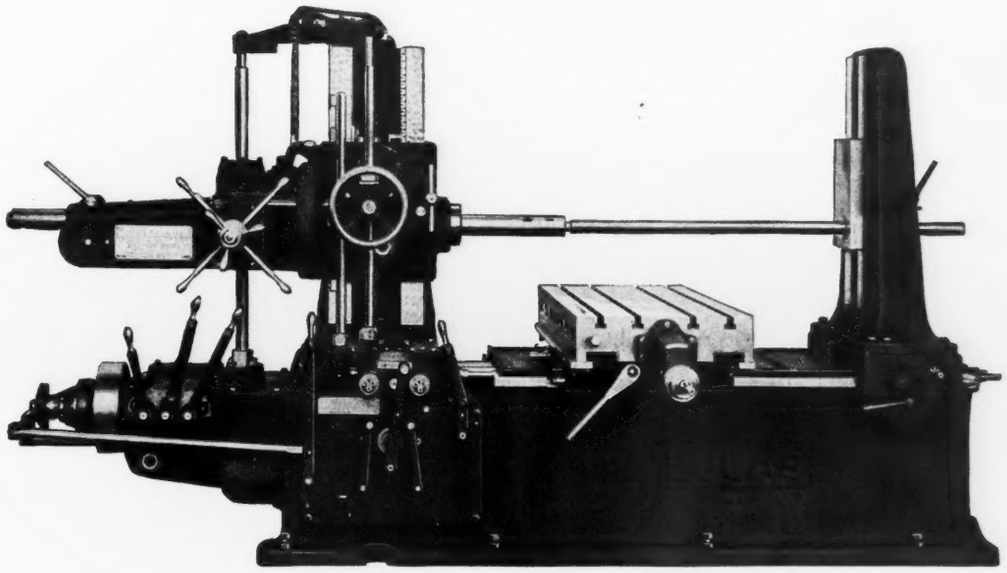
PUMPS. Ruthman Machinery Co., 532 E. Front St., Cincinnati, Ohio. Catalogue containing descriptive information and complete data covering the Gusher line of coolant pumps. A number of typical installations of these pumps are shown.

WELDING EQUIPMENT. General Electric Co., Schenectady, N. Y. Bulletin GEA-995A, entitled "Arc Welding in Industry," discussing the welding of machine parts, structural steel; tanks and pressure vessels; piping; jigs, fixtures, and dies; etc.

MATERIAL-HANDLING EQUIPMENT. Cleveland Electric Tramrail Division of the Cleveland Crane & Engineering Co., Wickliffe,

BIG

If you have enough work to warrant large jigs, originate them accurately and economically on the LUCAS "Precision" Horizontal Boring, Drilling and Milling Machine with Dial Indicator Indexing Device, utilizing standard end measuring rods and inside micrometers for exact spacing of holes. The indicators are quickly and easily read correctly and the measuring elements are not subject to appreciable wear, the traverse screws being used merely to adjust the slides to position. The alignments of the LUCAS "Precision" machine are beyond question and it has the necessary rigidity to maintain them.



JIGS

If the quantities of your various boring jobs are too limited to justify the investment in large jigs, which may become obsolete before they can be charged off, remember that "The LUCAS" is a jig in itself, adaptable to an infinite variety of boring, drilling and milling jobs. Comparatively inexpensive special length gages, corresponding to the center distances between holes to be bored in repetition production work, can be used with the Dial Indicator Indexing Device. This leaves you free to make improvements, involving changes in your product, without delay.

We are constantly improving the "Precision."

THE LUCAS MACHINE TOOL CO., Cleveland, Ohio

FOREIGN AGENTS: Allied Machinery Co., Barcelona, Zurich. V. Lowener, Copenhagen, Oslo, Stockholm. R. S. Stokvis & Zonen, Paris and Rotterdam. Andrews & George Co., Tokyo. Ing. M. Kocian & G. Nedela, Prague. Emanuele Mascherpa, Milan, Italy.

Ohio. Circular illustrating the application of the Cleveland overhead tramrail system in the foundry industry.

SMALL TOOLS. Brown & Sharpe Mfg. Co., Providence, R. I. Booklet containing detailed information on small tools recently added to the B. & S. line. The booklet lists a number of new machinists' tools, cutters, screw machine tools, and arbors.

LATHES. South Bend Lathe Works, 773 E. Madison St., South Bend, Ind. Bulletins 9 and 15, illustrating and describing in detail the new features of the 9-inch and 15-inch new model South Bend precision lathes. Specifications and prices are included.

NICKEL CAST IRON. International Nickel Co., Inc., 67 Wall St., New York City. Booklet entitled, "Notes on Uses of Nickel Cast Iron," covering applications of this material in the automotive, aeronautical, general machinery, machine tool, and power fields.

STEEL BELT CONVEYORS. Sandvik Conveyor Mfg. Co., 21-23 Amsterdam St., Newark, N. J. Catalogue 30, covering steel belt conveyors, containing numerous illustrations of installations, as well as tables, charts, and diagrams useful in solving conveyor problems.

SHAPERS. Western Machine Tool Works, Holland, Mich. Catalogue 80, illustrating and describing the features of construction of Steptoe Timken-bearing equipped shapers. The catalogue is profusely illustrated with large-scale halftones and reproductions of blueprints in natural colors.

ELECTRICAL MEASURING INSTRUMENTS. Roller-Smith Co., 233 Broadway, New York City. Bulletin 830, descriptive of graphic instruments for alternating and for direct current, including ammeters, voltmeters, single and polyphase wattmeters, and power factor meters.

RADIAL DRILLING MACHINES. General Radial Drill Co., Cincinnati, Ohio. Catalogue illustrating and describing the Gen-Rad and Hy-Rad radial drilling machines made by this company. The various features of design are shown, and complete specifications are given for the various sizes.

PUNCHES AND SHEARS. Henry Pels & Co., Inc., 90 West St., New York City. Catalogue MC-30, covering the Pels line of combination punches, plate shears, bar and tee cutters, and notchers. The various types are illustrated and described and complete specifications are included.

SMALL TOOLS. Ready Tool Co., 550 Iranistan Ave., Bridgeport, Conn. Pamphlet containing dimensions and prices of Ready shaper and planer tools, ball-bearing centers, high-speed steel lathe centers, lathe tools and tool-holders, milling machine dogs and drivers, cutting-off tools, belt sticks, etc.

TOOL ENGINEERING SERVICE. Cramp Mfg. Corporation, 2850 Fulton Blvd., Chicago, Ill. Catalogue illustrating the jig and fixture engineering service offered by this company. The illustrations show the various departments of the company and the shop equipment available for handling a wide variety of jobs.

SCREW THREAD GAGING AND MEASURING TOOLS. John-Sons Gage Works, Hartford, Conn. Catalogue 4, treating of the subject of screw thread gaging and the tools made by this concern for gaging and measuring screw threads. The tools are described in detail and instructions for ordering are included.

CHAIN. American Chain Co., Inc., Bridgeport, Conn. Catalogue containing facts and figures on all types of welded chain. Tables of sizes, weights, loads, and directions for taking measurements are included. Another feature of the book is information on how to order chain in accordance with the A.S.T.M. and A.R.A. specifications.

STELLITE PRODUCTS. Haynes Stellite Co., 30 E. 42nd St., New York City. Booklet entitled, "Haynes Stellite Products in the Oil Fields," describing Haystellite, a tungsten-carbide diamond substitute; Haynes Stellite, a hard-facing alloy of chromium, tungsten, and cobalt; and Hascrome, a chromium-manganese-iron welding rod.

JIG BORING MACHINES. Societe Genevoise d'Instruments de Physique, Geneva, Switzerland. (American agent, R. Y. Ferner Co., Investment Building, Washington, D. C.) Catalogue 546, covering the distinctive features of the four larger sizes of Swiss jig borers. Complete specifications are given, and a number of typical jobs done on these machines are illustrated.

MANAGEMENT ENGINEERING. Elliott Service Co., 242 W. 55th St., New York City, is distributing a wall chart listing 142 causes of waste which foremen can prevent. These cover waste of time; waste of ideas; waste of materials and supplies; waste of machinery and equipment; waste of man power; waste of accidents; waste of non-cooperation; and waste of space.

POWER TRANSMISSION EQUIPMENT. Stearns Conveyor Co., Cleveland, Ohio, Division of the Chain Belt Co., Milwaukee, Wis. Catalogue and engineering data book containing complete information on the designs and application of Rex-Stearns Timken idlers for all types of belt conveyors, together with auxiliary equipment required for belt conveyor installations.

NICKEL STEEL. International Nickel Co., Inc., 67 Wall St., New York City. Bulletins 15 and 16 in a series on nickel steel data and applications, dealing, respectively, with nickel-chromium steels for high-temperature service—valves and bolts—and approximate relations between Brinell, Rockwell, and Shore hardnesses and the tensile strengths of structural alloy steels.

PYROMETERS. Illinois Testing Laboratories, Inc., 141 W. Austin Ave., Chicago, Ill. Pamphlet entitled "Points the Way to Better Printing," descriptive of Alnor portable and stationary temperature measuring instruments for measuring the temperature of molten type metal and other soft metals, such as babbitt, lead, solder, and white metal, which are cast at low temperatures.

TUNGSTEN-CARBIDE TOOLS. Thomas Prosser & Son, 15 Gold St., New York City. Instruction sheet, illustrating and describing the proper way to grind Widia tungsten-carbide tools, and showing the use of a stainless steel gage or templet for grinding these tools to the proper angles. This gage, as well as the instruction sheet, will be sent free upon request to anyone engaged in machine shop work.

METAL CLEANING AND FINISHING PROCESS. Bullard Co., Bridgeport, Conn. Pamphlet descriptive of the Bullard-Dunn electro-chemical cleaning process for removing scale, oxides, and other foreign matter from the surface of metals without impairing the finish. In addition to removing foreign matter, the process produces a surface that is resistant to corrosion and suitable for subsequent electro-deposition of metals.

CENTRIFUGAL PUMPS. Barrett, Haentjens & Co., Hazleton, Pa. Bulletins 501, 505, 509, 512, 515, 520, 522, and 601, describing the most effective means of priming centrifugal pumps manually. These bulletins treat, respectively, of the theory of priming; submerged pumps; the use of foot valves; air, steam, and water ejectors; hand-operated priming pumps; motor-driven priming pumps; and arrangement of intake piping.

STEEL AND FORGINGS. Heppenstall Co., Pittsburgh, Pa. Booklet entitled "Serving Industry for Three Generations," giving a brief history of the Heppenstall Co., a grouping of the industries served by the company, and a review of the company's products, including acid open-hearth steel, die-blocks, shear knives, forgings, electric induction steel, and alloy steel. The booklet is a fine example of the printer's art, well illustrated.

SPEED REDUCERS. W. A. Jones Foundry & Machine Co., 4401-4451 Roosevelt Road, Chicago, Ill. Catalogue 45, of the line of herringbone and herringbone-Maag speed reducers made by this concern. The book is divided into three sections, the first of which discusses the design and manufacture of herringbone speed reducers; the second part contains tables for use in rating and selecting these reducers; and the third part shows a large number of actual installations.

MILLING MACHINES. Cincinnati Milling Machine Co., Cincinnati, Ohio. Catalogue covering the standard line of machine tools manufactured by this company and its associate company, Cincinnati Grinders, Inc. Illustrations, descriptions, and specifications of knee and column type automatic and hydromatic milling machines and cutter grinders are included, as well as illustrations and descriptions of centerless and center type grinding machines. The book is printed in three languages—English, French, and German.

ROLLER BEARINGS. Roller Bearing Co. of America, Trenton, N. J. Catalogue 40, listing the complete line of Heliflex roller bearings, which are made in sizes for application to shafts ranging from 3/8 inch to 10 inches in diameter. All the data required by designers is given in convenient tabular form, including shaft diameter; bearing length; diameter and number of rollers; outside diameter of bearing; shaft and housing bore dimensions; and capacities at various speeds. Load capacity tables for the different styles of bearings are also included.

METAL SPRAYING EQUIPMENT. Metals Coating Co. of America, 497 N. Third St., Philadelphia, Pa. Catalogue descriptive of the MetaLayer apparatus and process for simultaneously melting, atomizing, and spraying on any surface coating of any of the commercial metals. The catalogue describes the characteristics of sprayed molten metal coatings and shows examples of different applications of this process. Bulletin outlining the service test to determine the comparative protection of sprayed molten metal coatings as applied with "MetaLayer" and with two methods of painting.

SCALES. Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago, Ill. Catalogue entitled, "Beginning the Second Century," celebrating the centennial anniversary of the invention of the platform scale by Thaddeus Fairbanks and the founding of the company that bears his name. The catalogue goes into the history of the development of weighing machines and tells something of the accomplishments and the aims of the company that has fostered this development. An interesting feature is the pictorial comparison of the old weighing methods, shown by wood cuts, with the modern methods, illustrated by halftone engravings.

ELECTRIC EQUIPMENT. General Electric Co., Schenectady, N. Y. Bulletin GEB-75 entitled "Power in Flight," containing data on airplane engines. Bulletins 286C, 556C, 588C, 817A, 925A, 959A, 1117, 1157A, 1175A, 1186, 1187B, 1197, 1200, 1202 and 1247, dealing, respectively, with outdoor switching equipment; automatic welding head and control; motor-driven centrifugal compressors; battery charging equipment; station oil circuit breakers; vertical induction motors; strip heaters; magneto compass for aircraft; hook-operated disconnecting switches; engine temperature indicators for aircraft; brush-contact switches; air circuit breakers; capacitor motors; and enclosed starting rheostats.